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Devoted to Commercial and Naval Motor Craft

Vol. 3 No. 7
JULY, 1918

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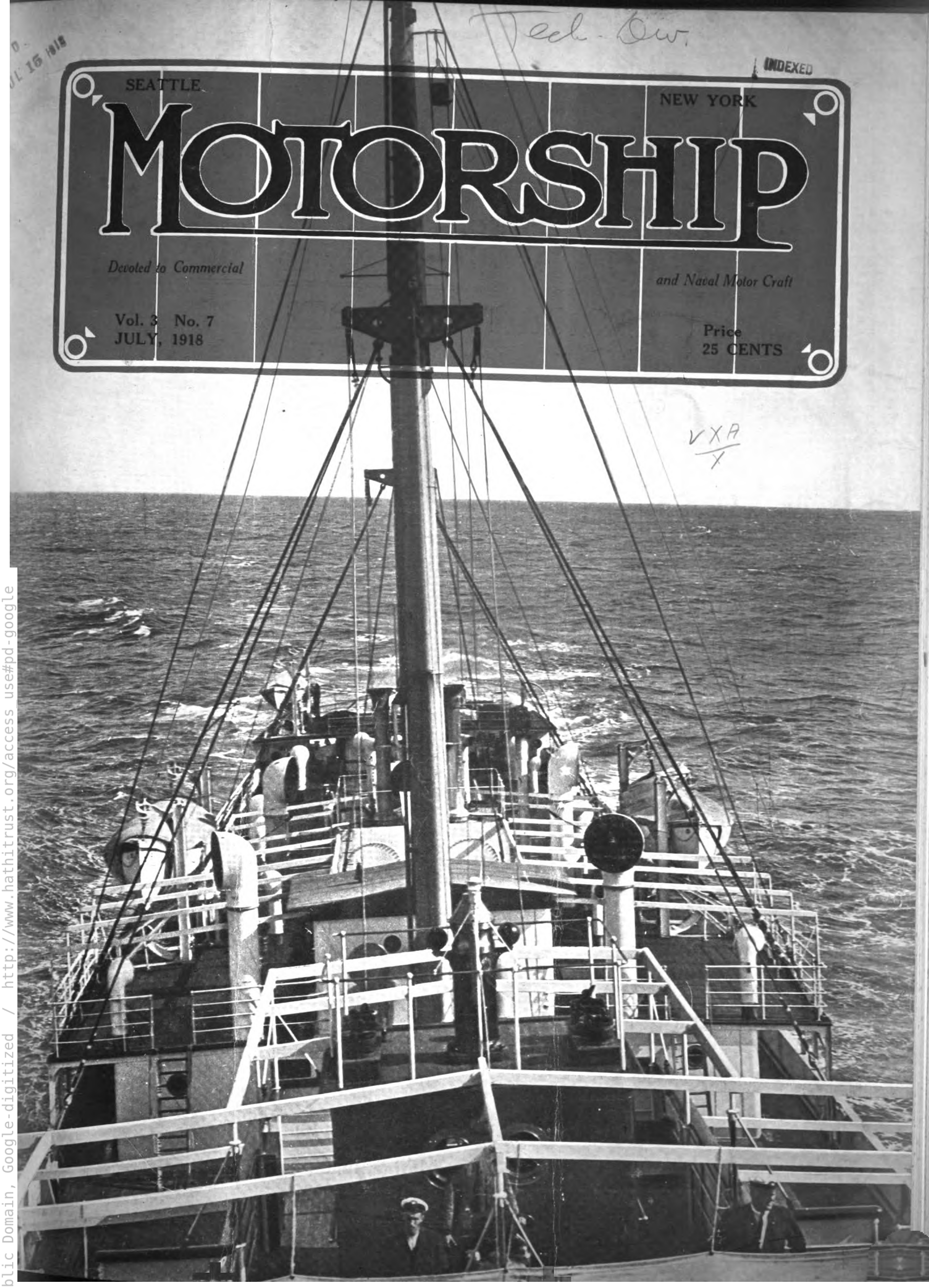

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MOTORSHIP

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July, 1918 Vol. 3 No. 7

LEADING EDITORIAL CONTENTS

Work of the Motorcraft at Zeebrugge and Ostend..... 7
The Wooden Auxiliary Schooner Question..... 10
Lyons-Atlas V.D.V. Marine Oil Engine..... 13
Oil Engine Sprayers and Pulverizers (Part II)..... 14
Extracts from a Motorship's Log..... 16
The Heavy-Oil Engine from a Scientific Standpoint..... 19
Concrete Motor Tankships..... 20
The Internal-Combustion Engine..... 21

PRINCIPAL ILLUSTRATIONS

Submarine Patrol-Work in the North Sea..... 6
The Zeebrugge Raid..... 7
Lyons-Atlas V.D.V. Marine Oil Engine..... 13
Types of Fuel Injectors..... 14
The Motorship "Juno"..... 16
Dr. E. Lucke..... 19
A Solid-Injection System..... 21
The Auxiliary "Itamaraca"..... 22

EDITORIAL

The oil-engined motorship is such a pronounced economy that it must come. Nothing can stop it! And all obstacles will be removed as fast as they rise. The law of progress will see to that. Very strong prejudices stood in the way of steam. But, one after another they were swept aside and steam reigned triumphant for a century. Steam now has had its day! Its zenith has passed, and gradually but surely it is being superseded by the economical internal-combustion power. America, the most important oil-producing country, will be the greatest motorship-owning nation. Let us all co-operate and assist to make that day soon!

ENGINEERS AND THE FUTURE OF MOTORVESSELS

IN the past every domestic steamship-owner has learned a lesson from, or has had the opportunity of digesting, the many troubles arising from the worrying stoker question and from the results of having to put-up with indifferently trained steam-engineers. This leads one to presume that with the dawn of a new era in American shipping the manual side of the operation of ships would have been thoroughly prepared in advance. Whereas, in actual practice far too little attention has been given to the motorship-engineer problem by shipowners, and many do not seem to have been endowed with sufficient prescience to have properly understood that in the word "engineer' lies the crux of the entire future motorship situation.

"Motorship" frequently has indicated the need for properly trained engineers, the training of which must be arranged by shipowners, whether such are private persons or the Shipping Board. But, nothing has been done in the way of providing a training motorship. Yet the latter is absolutely essential for the future of America's merchant marine. Up to the present some domestic owners unwisely have been content to wait until their motorships are ready for service and then rely upon the various marine engineer's associations and agencies to furnish the engine-room crews, and several American motorships even have been sent to sea with their engineers absolutely unfamiliar with oil motors. Consequently t is no wonder that machinery develops trouble under such conditions. Other shipowners have used better judgement and have selected reliable steam-engineers or mechanics and have sent them to the engine-builders' works for several months in order that their knowledge may grow with he motors.

Without doubt a great number of large merchant motorships will be placed in service before long by various departments of the United States Government in addition to many smaller motor-vessels by private owners, and for these ships responsible motor-engineers will be required. Capable marine steam-engineers cannot be spared for the time required for training into the peculiarities of operating oil-engines, as there already is too great a demand upon their services. This, by the way, alone makes it necessary to repeal the regulation that motorship engineers must have a steam-engineer's certificate.

Whatever classes of men are selected to run the machinery of America's future merchant motorship marine, they must be well trained; for the best designed and constructed of marine oil-engines cannot be expected to give reliable service in the hand of indifferent or half-trained operators.

A considerable number of good operators can be taken from the hundreds of stationary oil-engine power-plants about the country, as, with a few months sea-training most of these men will make ideal motorship engineers. Good mechanics also can be used. If necessary these engineers can be drafted, but they must be transfered from their present occupation to the engine-rooms of motorships. Other good motorship engineers can be made by enlisting the services of several hundred chauffeur-mechanics and sending them to the Diesel engine-builders works for three or four months. The Columbia University of New York is doing some highly valuable work training men to be marine engineers.

But, for all classes of men a training ship, or two, must at once be built, and there should be no further delay on this score. The latter two classes of men particularly will need a final training aboard ship in addition to shop experience in order that they may find their "sea-legs," and in order that they may become properly familiar with the hundred-and-one duties in the engine-room of motorships.

The present training of engineers really is in the hands of the Shipping Board, as the latter in a sense now is equalivent to the private shipowner of pre-war days. So it is up to the Shipping Board to arrange for the Emergency Fleet Corporation to provide one or several training motorships without further delay. Much depends upon this being done immediately, as we can't afford to build motorships and have them held-up for repairs due to bad operation. We must have motorships, and we must have efficient operators! Then America's mercantile supremacy will be within easy reach!

AMERICA'S NEW DESTROYER FLEET

AS a single-unit anti-submarine weapon the modern turbine-destroyer up to the present is unexcelled; except perhaps by Italy's new Diesel-driven "mystery craft". So it is not surprising that the current policy of the U. S. Navy Department is to build destroyers in as large numbers as possible. But, surely their construction in big fleets will create a difficulty, namely that of the oil-fuel supply? And, upon an adequate oil-fuel and gasoline supply to Europe rests the winning of the war. For, as we previously have shown, if Germany is successful in her attempts to stop the entire overseas transportation of oil it means a serious blow for our gallant allies as soon as their reserve supply is gone.

Many of these new T.B. destroyers each have between 25,000 and 30,000 horse-power, so at full speed must consume in the neighborhood of 12 long-tons of oil-fuel per hour. But, comparatively little submarine-patrol work is carried out at full speed, as the destroyers cruise round at somewhere about 18 to 20 knots under average circumstances. Even at that speed they are using an enormous amount every hour of fuel-oil, as turbines are very uneconomical at low power. All of which oil has to be transported across the Atlantic, or from other parts of the world—but nevertheless overseas—and it is on the high seas that the tankships are subject to submarine attack and are constantly being sunk, adding to the present shortage of ocean-going tankers. The new submarine campaign off our Atlantic coast also renders coastwise tank-barges liable to attack.

Obviously the fuel transportation problem would have been greatly simplified if every destroyer were, in addition to the turbines, fitted

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with a submarine-type Diesel engine of 1,000 to 2,000 shaft-horsepower to be used mainly for cruising at half-speed. Such an engine would give a 1100-ton destroyer ample speed for cruising, on a fuel-consumption of ¼ to ½ ton of crude-oil per hour, leaving the steam-turbines to be used principally for high-speed work.

A fleet of one-hundred destroyers, each fitted with a 2,000 shaft-horsepower Diesel-engine, for cruising, would only require a total maximum of 8,400 tons of fuel per seven days of 24 hours per day, apart from the fuel needed to keep a good pressure of steam under the boilers when idle and for running at full speed.

A fleet of one-hundred destroyers, if purely steam driven, would require about 201,600 tons of oil-fuel for the same period if driven continually at full speed. However they will not, as just mentioned, be driven at full-speed for lengthy periods, so probably this consumption would be reduced to at least one-third, namely approximately 67,200 tons. And, if the destroyers were Diesel-driven when patrolling at cruising speed, there would be a direct saving of over 58,800 tons every week, or 235,200 tons per month. What this means to the present oil transportation facilities, and to the oil supply, is a simple matter to calculate. Also it is a factor that cannot well be ignored.

Just before the outbreak of the war the Japanese Admiralty ordered four destroyers, each with a 1,000 bhp Diesel engine for cruising operating at speed. Previous to that the British Government ordered a 1,000 bhp Diesel engine to be installed in the then new destroyer "Hardy", but this vessel went into commission without the Diesel engine, because the designers, through lack of proper marine heavy-oil engine experience, did not make a success of the Diesel job. Thus it will be understood that the proposal is not a new one, nor can it be regarded as impractical.

AMERICA'S FUTURE MERCANTILE MARINE

WE are building ships not alone for the war, but for the future world trade. Other nations are making ready to meet the condition that will arrive with peace. What are we doing? What are we planning to do? When ships are ready for commerce after the war, will our merchants and manufacturers be ready for greater overseas enterprises? The Webb bill authorizing cooperation in export trade is now a law; but, this is not sufficient without the spirit to take advantage of it, and the knowledge on the part of the business men that their ventures into foreign markets will be supported by a strong national policy tending to encourage efficient production, convenient finance and cheap transportation."—*Extract from the Hon. Edw. Hurley's speech at a dinner to Mr. Isaac Marcosson.*

These are splendid ideals; that every American will endorse but, it is not impossible effectively to carry them out by building steamships, particularly of the coal-burning type. We must build motorships, and build motorships America undoubtably will! Some time ago, we expressed an opinion that before the United States will be the greatest motorship-owning country in the world. We have a reason for reiterating that remark, with the added belief that at last the United States is awake to what motorships really mean to the country both during and after the war.

VALUABLE WORK OF ITALIAN MOTOR TORPEDO-BOATS

For the second time Italian motor-driven torpedo-boats have succeeded in torpedoing Austrian battleships, altogether making four badly damaged or sunk, and the gallant work of the commanders of these little motor craft no doubt will receive proper recognition. It is the belief of a prominent official of Ansaldo & Co. that these motor-boats are the little 40-footers which they built and fitted with Sterling (American) gasolene motors. All the more glory to the American marine motor industry!

SHIPPING BOARD WILL ENCOURAGE BUILDING SMALL MOTORSHIPS

The Shipping Board are to be congratulated for their decision to encourage the construction of small wooden motorships both for domestic and foreign account, and we hope to see a further step taken, namely to order all suitable existing sailing-vessels to be equipped with auxiliary motor-power, and to insist that no new sailing-vessel shall be completed without auxiliary propelling power.

MOTOR-DRIVEN EMERGENCY WIRELESS AND LIGHTING SETS ON DECK

The removal of 80 tons of copper followed by the sinking of the steamship "Vindeggen" by a German submarine, within two hundred miles of the well-patrolled American coast, effectively demonstrates the importance of installing an internal-combustion-engine-driven emergency wireless and electric lighting-set on the deck of every steam and sailing-ship, as advocated months ago in "Motorship". Flooding of the engine and boiler rooms would not affect operation of such an installation. There are many good builders of small marine gasolene motors who would be only too glad of the opportunity to build large quantities of equipments. Why has there been a delay?

SINKING SUBMARINES BY THE SCORE

AS we write some German U-boats are operating off the U. S. Atlantic coast, and have been for nearly two weeks. Before us is an evening paper which contains several vivid accounts of the sinking of *at least six* giant U-boats off the coast. At the foot of one of these accounts appears the following paragraph:—

> "Incidentally the American naval headquarters abroad has cabled the Navy Department asking if it cannot stop circulations of skippers and sailors' yarns about sinking of submarines in places where the evidence of destruction is, to say the least, extremely doubtful."

We presume that the daily press must have "stories" to fill their colums; but, the publication of these foolish unofficial yarns regarding submarine sinkings does not help to win the war; but, rather tends to give too much over-confidence among the general public, inasmuchas they begin to believe that it is quite a simple matter to sink or capture a modern submarine and that it is only necessary to fire a "pop-gun" and the U-boat instantly is rendered "hors de-combat."

If all the submarine sinking 'yarns' were true Germany must have lost over a thousand U-boats since she started her vile campaign. These stories ultimately find their way into Germany, and cause the Germans to "make-fun" of us. No wonder some of them do not yet seriously regard America's magnificent war preparation. A stoppage of these 'yarns' will do much to make Germany realize that she has against her, in America, a country that is doing wonderful things in the way of making war. When the time comes the Allied navies will publish the figures concerning submarine destroyed and captured. Meanwhile let us delete obvious nonsense.

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This remarkable photograph, taken at sea from a mine-sweeper personally by F. J. Mortimer, F. R. P. S., indicates one of the reasons why "Motorship" from the first has advocated a class of Diesel-driven submarine-destroyers large enough to attack the big U-boats in all weathers. Such seas are of frequent occurrence where enemy submarines are operating. Judging by the destroyer, which towers above the mine-sweeper on the crest of a wave, the latter are running from 20 to 30 feet high from trough to crest and are about half-a-mile from crest to crest.—From "The Graphic," London.

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Work of the Motor-Craft at Zeebrugge and Ostend

The British Admiralty's Official Story

Never in the history of the marine internal-combustion-engine have motor-craft played so valuable a part in naval warfare as they did in the recent magnificent raids on Zeebrugge and Ostend by the British Navy. The gallant work of the commanders and crews of these motorboats are motorlaunches, who mostly were yachtsman, fisherman, mechanics, etc., that volunteerd at the outbreak of war, will live forever in the memories of sea-going men.

"Motorship" has constantly pointed out the necessity of building hundreds and even thousands of motorboats, as well as larger heavy-oil driven craft, for the multitude of naval duties for which they are exceptionally well fitted. The difficult tasks at Zeebrugge and Ostend were of a nature more suited to this class of vessel than any other type of naval craft, and well they accomplished their job.

Through the courtesy of the British Admiralty "Motorship" is enabled to give the Admiralty's official narrative of the two raids on Zeebrugge and of the raid at Ostend. But, owing to pressure on space we are obliged to leave out parts of the description dealing with the equally wonderful work of those aboard the other naval craft, such as the destroyers, ferry-boats, monitors, obselete cruisers, etc. The latter, however, already has been fully outlined in the daily press.

According to the official report there were two types of motorcraft used, viz:—Motorboats and motorlaunches. The motorlaunches were, of course, the 80-footer, or M.Ls., that were built in America (see June issue) while the motorboats probably were the American-built 110 footers, or larger oil-engined craft constructed in Great Britain. This the Admiralty should announce! It will be noted that they were "torpedo-boats," and their torpedoes did the greatest harm to the piers at Ostend. The two fleets of motorcraft were under different commanders. We now will proceed to give the British Admiralty's official story just as we received it, with the exception of the deleted parts (denoted by asterisks) referred to above.—The Editor.]

The First Zeebrugge Raid

From the "Vindict.ve's" bridge, as she headed in towards Zeebrugge mole, there was scarcely a glimmer of light to be seen shorewards. Ahead of her, as she drove through the water, rolled the smoke screen, her cloak of invisibility, wrapped about her by the small motor craft. This was a device of Wing-Commander Brock, R. N. A. S., "without which," acknowledges the Admiral in Command, "the operation could not have been conducted." * * * The "Thetis" came first, steaming into a tornado of shell from the great batteries ashore. All her crew, save a remnant who remained to steam her in and sink her, had already been taken off by the ubiquitous motor-launches; but the remnant spared hands enough to keep her four guns going. She cleared the string of armed barges (German) which defends the channel from the tip of the mole, but had the ill fortune to foul one of her propellers upon the net defence which flankes it on the shore side. The propeller gathered in the net and rendered her practically unmanagable; the shore batteries found her and pounded her unremittingly; she bumped into a bank, edged off and found herself in the channel again, still some hundreds of yards from the mouth of the canal, in a practically sinking condition. Commander R. S. Sneyd, D. S. O., accordingly blew the charges and sank her. A motorlaunch under Lieut. H. Littleton, R. N. V. R., raced alongside and took off her crew.

The "Intrepid," smoking like a volcano and with all her guns blazing, followed; her motor-launch had failed to get alongside outside the harbor. * * * a motor-launch, under Lieut. P. T. Deane, R. N. V. R., had followed them in to bring away the crews (of the "Intrepid" and "Iphigeni") and waited further up the canal towards the mouth against the western bank. Lieut. Bonhan Carter, having sent away his boats, was reduced to a Carley float, an apparatus like an exaggerated life-buoy with a floor of grating. Upon contact with the water it ignited a calcium flare and he was adrift in the uncanny illumination with a German machine-gun a few hundred yards away giving him its undivided attention. * * * He managed to catch a rope as the motor-launch started and was towed for a while till he was observed and taken on board. Another officer jumped ashore and ran along the bank to the motor-launch. A bullet from the machine-gun stung him as he ran, and when he arrived, charging down the bank out of the dark, he was received by a member of the launch's crew who attacked him with a hammer.

The whole harbor was alive with small craft. As the motor-launch cleared the canal, and came forth to the incessant geysers thrown up by the shells, rescuers and rescued had a view of yet another phase of the attack. The shore end of the mole consists of a jetty and here an old submarine, commanded by Lieut. R. D. Sandford, R. N., loaded with explosives, was run in to the piles and touched off, her crew getting away in a boat to where the usual launch awaited them. Officers describe the explosion as the greatest they ever witnessed—a huge, roaring spout of flame that tore the jetty in half and left a gap of over 100 feet.

The claims of another motor-launch to have sunk a torpedo-boat alongside the jetty is supported by many observers, including officers of the "Vindictive," who had seen her mast and funnel across the mole and noticed them disappear.

Where every moment had its deed and every deed its hero, a recital of acts of valor becomes a mere catalog. "The men were magnificent," say the officers; the men's opinion of their leaders expresses itself in the manner in which they followed them, in their cheers, in their demeanor to-day while they tidy up their battered ships, setting aside the inevitable souvenirs, from the bullet-torn engines to great chunks of Zeebrugge mole dragged down and still hanging in the fonders of the "Vindictive."

The motor-launch from the canal cleared the end of the mole and there beheld, trim and ready, the shape of the "Warwick," with the great silk flag, presented to the Admiral by the officers of his old ship the "Centurion." They stood up on the crowded decks of the little craft and cheered it again and again. * * *

At Ostend

The wind that blew back the smoke at Zeebrugge served us even worse off Ostend, where that and nothing else prevented the success of a operation ably directed by Commodore Hubert Lynes, C. M. G. The coastal motor-boats had left the approaches and the ends of the piers with calcium flares and made a smoke cloud which effectually hid the fact from the enemy. The "Sirious" and "Brilliant" were already past the Stream Bank buoy when the wind changed, revealing the arrangements to the enemy who extinguished the flares with gunfire.

The "Sirius" was already in a sinking condition * * * their crews were taken-off by motor-launches under Lieut. K. R. Hoare, R. N. V. R. and Lieut. R. Bourke, R. N. V. R. The motor-launches here were under the command of Commander Hamilton Benn, R N. V. R., D. S. O., M. P., while those at

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The Most Daring Adventure—The Raid on Zeebrugge (From the "Graphic")

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Zeebrugge were commanded by Captain R. Collins, R. N. (the Vice-Admiral's Fag Captain). All the coastal motor-boats were commanded by Lieut. A. P. Wellman, D. S. O., R. N. * * *

The Second Ostend Raid

The "Sirius" was in the surf some two thousand yards east of the entrance to Ostend harbor, which she failed so gallantly to block; during the first raid, and when the "Vindictive" groped her way through the smoke-screen and headed for the entrance, it was as though the old fighting ship awoke and looked on. A coastal motor-boat had visited the "Sirius," and had hung a flare in her slack and rusty rigging. * * *

The planning and execution of the following success had been entrusted by the Vice-Admiral, Sir Roger Keyes, to Commodore Hubert Lynes, G. M. G., who directed the previous attempt to block the harbor with "Sirius" and "Brilliant." * * * It was a night that promised well for the enterprise—nearly windless and what little breeze stirred came from a point or so west of north a sky of lead-blue, faintly star-dotted, and no moon; a still sea for the small craft, namely the motor-launches and the coastal motor-boats, whose work is done close-in shore. From the destroyer which served the Commodore for flagship, the remainder of the force was visible only as swift silhouettes of blackness, destroyers bulking like cruisers in the darkness, motor-launches like destroyers, and coastal motor-boats showing themselves as racing hillocks of foam. * * *

The "Vindictive" receded into the night astern, as the destroyer raced on to lay the light buoy that was to be her guide. She passed thence into the hands of the small motor-craft, whose mission it was to guide-her, light-her and hide-her in the clouds of the smoke-screen. * * * The "Vindictive," always at that solemn gait of hers, found the flag-ship's light-buoy and bore up for where a coastal motor-boat, commanded by Lieut. Wm. R. Slayter, R. N., was waiting by a calcium flare upon the old position of the Stroom Bank buoy. Four minutes before she arrived there, and fifteen minutes only before she was due at the harbor mouth, the signal for the guns to open was given.

Two motor-boats, under Lieut. Darrel Reid, R. N. R., and Lieut. Albert L. Poland, R. N., dashed in towards the ends of the high wooden piers and torpedoed them. There was a machine gun on the end of the western pier and that vanished in the roar and the leap of flame and debris. Over the town a flame suddenly appeared high in air and sank slowly earthwards—the signal that our aeroplanes had seen and understood; anl almost coincident with their first bombs came the first shells whooping up from our monitors at sea. The surprise part of the attack was sprung!

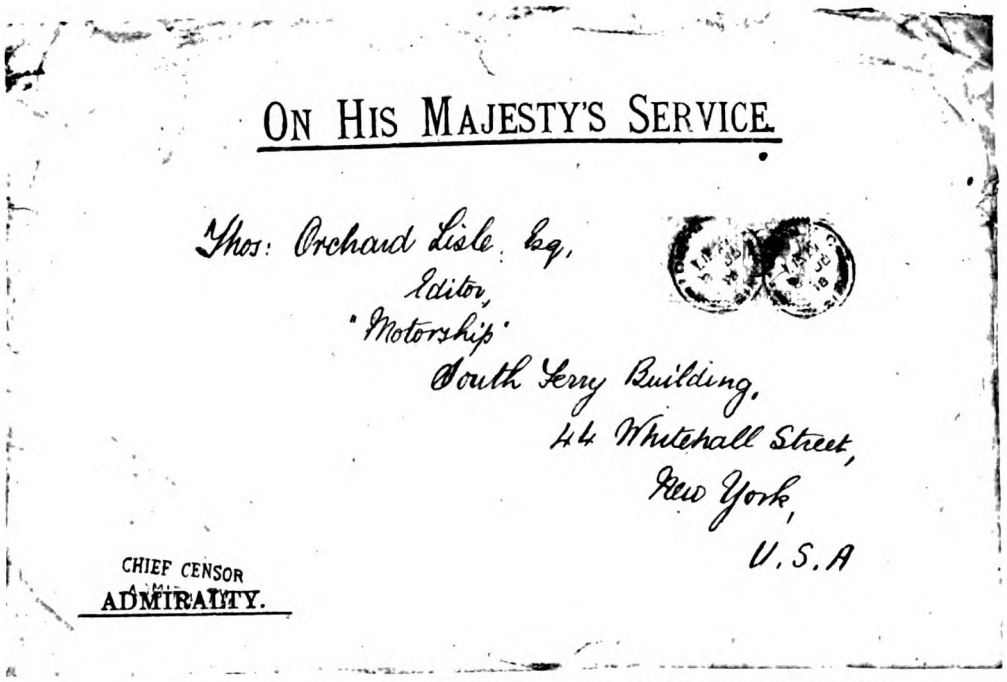
The surprise, despite the Germans' watchfulness, seems to have been complete. Up till the moment when the torpedoes of the motor-boats exploded, there had not been a shot from the land—only occasional routine star-shells. The motor-launches were doing their work magnificently. These pocket-warships, manned by officers and men of the Royal Naval Volunteer Reserve, are specialists at smoke production; they built on either hand of the "Vindictive's" course, the likeness of a dense sea-mist driving landward with the wind. * * *

There was a period of tremendous uproar. The coast about Ostend is ponderously equipped with batteries. * * * These now opened fire into the smoke and over it at the monitors; the Marines and the monitors replied; and meanwhile the aeroplanes were bombing methodically and the anti-aircraft guns were searching the skies for them. * * * It was then that those on the destroyers became aware that what had seemed to be merely smoke was wet and cold, that the rigging was beginning to drip, that there were no longer any stars—a sea fog had come on!

The destroyers had to turn on their lights and use their syrens to keep in touch with each other; the air attack was suspended, and "Vindictive," with some distance yet to go, found herself in gross darkness.

There were motor-boats to either side of her, escorting her to the entrance, and these were supplied with what are called Dover flares—enormous lights capable of illuminating square miles of sea at once. A "Very" pistol was fired as a signal to light these, but the fog and the smoke together were too dense for even the flares. "Vindictive" then put her helm over and started to cruise to find the entrance. Twice in her wanderings she must have passed across it and at her third turn, upon reaching the position at which she had first lost her way, there came a rift in the mist and she saw the entrance clear, the piers to either side and the opening dead ahead.

The inevitable motor-boat dashed up (No. 22, commanded by Actg. Lieut. Guy L. Cockburn, R. N.), raced on into the opening under a heavy and momentarily growing fire, and planted a flare on the water between the piers. The "Vindictive" steamed over it and on. She was in. The enemy guns found her at once. She was hit every few seconds after she entered, her scarred hull broken afresh in a score of places and her decks and upper works swept. * * * Machine-guns at the inshore ends of the pier, from a position on the front and from machine-guns apparently firing over the eastern pier there converged upon her a hail of lead. * * * Most of the casualties were incurred while the "Vindictive" was being abandoned. The men behaved with just that cheery discipline and courage which distinguished them in the Zeebrugge raid. Petty-Officer Reed found Lieut. Alleyne in the conning tower, still unconscious and carried him aft under a storm of fire from the machine-guns. Lieut. Alleyne was badly hit before he could be got over the side and fell into the water. Here he managed to catch hold of a boat-fall, and a motor-launch under Lieut. Bourke, R. N. V. R., succeeded in rescuing him and two



How the story of the Ostend and Zeebrugge raids reached "Motorship"

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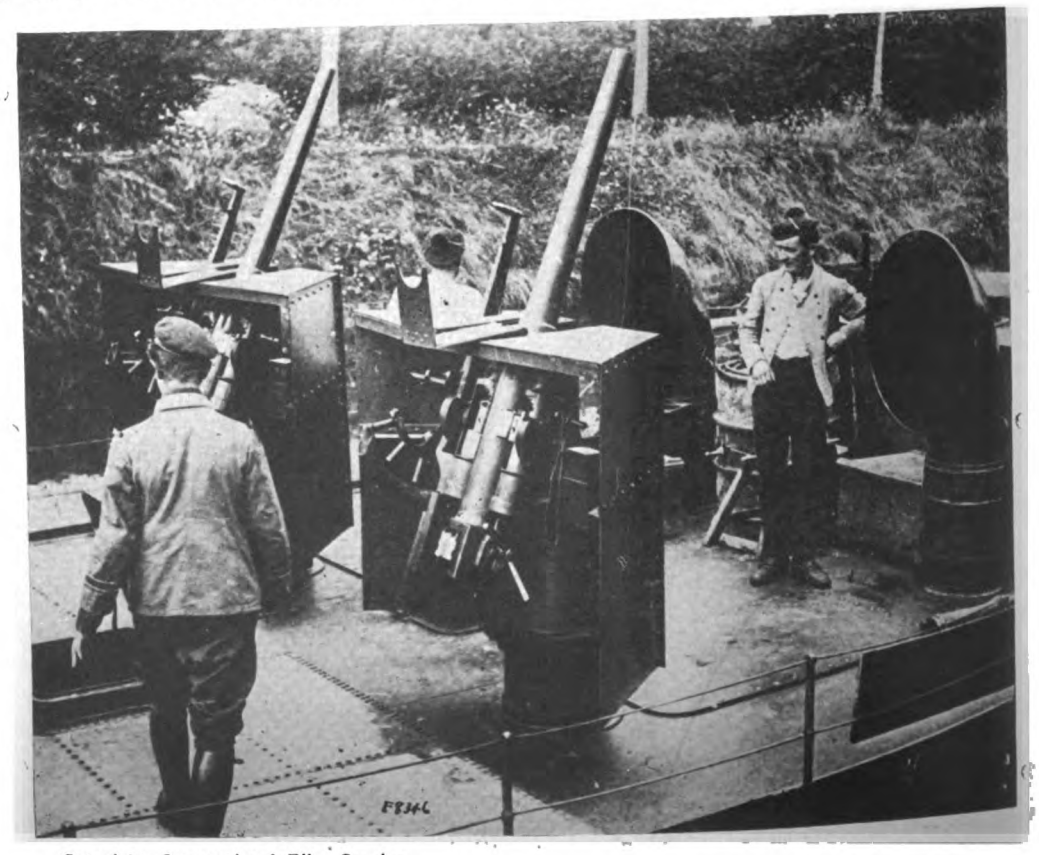
A motor barge laden with British "Tommies" towing another soldier-laden barge on the French canals in the battle area. One of the many valuable uses to which the internal-combustion-engine has been put during the war.



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A French motor gunboat on the river Aisne. The guns are anti-aircraft weapons.

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other wounded men. The remainder of the crew were taken off by motor-launch 254, under Lieut. G. H. Drummond, R. N. V. R., under a fierce fire.

When finally he reached the "Warwick" the motor-launch was practically in a sinking condition; her bows being shot to pieces; Lieut. Drummond was himself severaly wounded, his second in Command, Lieut. Gordon Ross, R. N. V. R., and one hand, were killed; a number of others were wounded. The launch was found to be too damaged to tow and day was breaking; she and the "Warwick" were in easy range of the forts; so as soon as her crew and the "Vindictive's" survivors were transferred, a demolitien charge was placed in her engine-room and was sunk.

Always, according to programme, the recall rockets for the small craft were fired from the flagship at 2.30 a. m. * * * The work was done, and one by one the motor-launches and motor-boats commenced to appear from the fog, stopped their engines alongside the destroyers and exchanged news with them. There were wounded men to be transferred and dead men to be reported—their names called briefly across the water from the little swaying deck to the crowded rail above. But no one had seen a single enemy craft; the nine German destroyers who were out and free to fight had chosen the discreeter part.

Vice-Admiral Sir Roger Keyes was present at the operation in the destroyer "Warwick." Commander Hamilton Penn, R. N. V. R., D. S. O., M. P., was in command of the motor-launches, and Lieut. Francis C. Harrison, D. S. O., R. N., of the Coastal motor-boats. The central smoke-screen was entrusted to Sub-Lieut. Humphrey V. Lew, R. N., and Sub-Lieut. Leslie R. Blake, R. N. R.

General Motorship and Engine Notes

MOTORSHIPS CARRY COAL

The economy of the motorship is so remarkable that it is the cheapest form of shipment for coal, and recently many motorships have thus been employed on the Atlantic coast.

OUR COVER PICTURE

The vessel shown in the illustration on the cover of this issue is the Norwegian motorship "George Washington," a steel Diesel-driven vessel. For the beautiful photograph we are indebted to Mr. Hubert Verhey.

SPANISH MOTORSHIPS

A 2,000-ton wooden motorship has been launched at the San Felippe Shipyard at Ferrol, and is fitted with two 400 b. h. p. Diesel engines, which we understand are of the Sulzer two-cycle type. She has been built for Senores Deza Y Pereira.

At Barcelona a new shipyard is being laid down by Don Carlos Mallol where auxiliary motorships of 2000 tons gross will be built.

ERRATUM

Once in a while the "printer's devil" mixes up the type. On page 12 of our June issue it was stated that an idea of the size of the Sulzer submarine engine could be obtained by the fly-wheel. This, of course, should have read "control-wheel" as the words that followed indicated. Also on page 21, five lines from the paragraph entitled "Increases to Italian Motorship Yards" were accidentally included in the paragraph headed "Six Hundred-Ton Concrete Motorship."

TWO MOTORSHIPS FOR THE DANISH SHIPPING COMPANY

The Danish Shipping Company which runs steamship services between the German and Danish cities, Lubeck, Nakskov, Svenborg and Aarhus, have recently put into service the motorship "Veda," whilst they have ordered an auxiliary of 160 tons, to be equipped with a 100 h. p. motor, from the Svenberg shipyard, to be delivered this year.

NEW MOTORSHIP FOR THE NORTH STAR COMPANY

The motorship "Lima" ordered by the North Star Shipowning Company, of Stockholm, was recently launched at the yards of Messrs. Burmeister & Wain, of Copenhagen. This vessel, which is of the builders' standard type, measures 57 feet in length, with a beam of 51 feet 3 inches and a depth of 34 ft She is driven by two four-stroke Diesel engines, which develop 1,600 i. h. p.

MOTORSHIP BUILDING ON SPECULATION

A motorship of 2,500 tons due is being built on speculation at the Finnboda Shipyard, Sweden, the works of the company having been extended for the purpose. New capital has been introduced with a view to building a number of these vessels. The dimension of the motorship under construction are as follows:

Length	227′ 6″
Breadth	41′ 0″
Draught	17′ 0″

The propelling machinery consists of two Polar reversible Diesel-engines of 650 bph each, built by the Atlas Diesel Works, Sickla. At this yard a Diesel-driven tanker recently was completed for Russian owners.

COUNT LUXBURG GOES HOME ON A MOTORSHIP

When the Swedish motorship "Suecia" left Buenos Aires recently she carried Count Luxburg, the German minister to the Argentine, also the German minister to Peru and the German Charge d'Affaires of Uruguay. Count Luxburg is the author of "Spurlos Versenkt." The motorship "Suecia" was placed in service in December, 1912, and is of 9,625 tons displacement and of 6,550 tons D.W.C., being owned by the Nordstjerna Star Company of Stockholm. Her length is 362′ by 51′ 3″breadth and 25′ 6″ depth. She is driven by two 1,000 I.H.P. Burmeister & Wain Diesel engines.

DANISH CONCRETE SHIPS

The Cordan Co. of Copenhagen is erecting a concrete shipbuilding yard at Kjoge, Denmark. There are three other concrete shipyards in that country.

BURMEISTER & WAIN'S PROFITS

A number of licenses to build Burmeister & Wain marine Diesel engines were granted in various foreign countries during 1917. The net profits of the Burmeister & Wain Co. during last year were $1,775,000 and a dividend of 22% was declared.

GREAT MOTORSHIP COMPANY DOUBLES ITS CAPITAL

The East Asiatic Company of Copenhagen, Denmark, which is one of the largest motorship owning companies in the world, is doubling its share capital, new shares to the value of $6,900,000.00 being offered to old stockholders at 150%. The present price of the old stock is about 690 per cent. With new issue the share capital of the company, with reserves, will amount to about $27,500,000.00. Its profits were $9,850,000.00 and it has a bank balance of $8,800,000.00.

DIESEL ENGINE CONSTRUCTION PROFITS

The A. B. Atlas Diesel of Stockholm, builders of the Polar marine Diesel oil-engine, formed in 1917 with a capital of five and a half million dollars (20,000,000 crowns) made a net profit during the first year's operations of 2,829,000 crowns, (about three-quarter million dollars). The total sales for the last year amounted to 41,400,000 crowns (over 11,000,000 dollars.)

A dividend of 12% has been paid for 1917 by the Akers Mekeniste Verksted Aktieselskabet, of Christiana, Norway, builders under license of the Burmeister & Wain marine Diesel oil-engine.

THE APPEARANCE OF "NAUTICUS"

Shipping men doubtless will welcome the appearance of "Nauticus," a new journal of shipping, insurance, investments, and engineering, published at 15 Whitehall Street, N. Y. C. It is edited by that well-known writer of shipping lore, R. de Tankerville, who for many years was editor of "Shipping Illustrated." From the first few issues of "Nauticus," we prophesy quite a future for it. From a printing and editorial make-up point of view, it leaves little to be described, whilst its editorial matter is fully up to Mr. de Tankerville's best. We wish "Nauticus" every success.

BOOKS RECEIVED FOR REVIEW

We have received a number of interesting and valuable books for review; but, owing to unusual pressure on space we have been obliged to hold-over the reviews until our next issue. The books are as follows:—

"Jane's Fighting Ships" (1919) Edited by Maurice Prendergast. Publishers, Sampson Low Marston & Co. 25 shillings net. Van Nostran & Co. U.S.A. Distributers.

"Navigation," by Frank Seymour Hastings. Publishers, D. Appleton & Co., New York. Price 75 cents.

"Internal Combustion Engine Manual" by F. W. Sterling. Publisher, Beresford, Washington, D. C.

"Marvel Book of American Ships," by Captain Orton P. Jackson and Major Frank E. Evans. Publishers, Frederick A. Stokes Co., New York.

"Fore and 'aft." Publishers, Newburgh Shipyards, Inc., Newburg, N. Y.

"Handbook of Ship Calculations Construction and Operation," by Charles H. Hughes. Publishers D. Appleton & Co., New York.

"Directory of Shipowners," Shipbuilders & Marine Engineers, 1918". Publishers, The Directory Publishing Co., Ltd., London, England.

"Nauticus," Edited by R. de Tankerville. Publishers, Nauticus Co., New York City.

"How Wooden Ships Are Built," by H. Cole Estep. Publishers, The Penton Publishing Company, Cleveland, Ohio.

We will be glad to obtain and forward any of these books on the behalf of our readers.

ANOTHER DANISH MOTORSHIP-OWNER'S PROFITS

For the year of 1917 the United Steamship Company of Copenhagen, Denmark, who own and operate several large Diesel-driven motorships, have paid a dividend of 35% from a net profit of $6,550,000.00. The previous year the same dividend was declared. This company now have taken up motorship building on an extensive scale, in addition to motorship operating.

RUSSIAN MERCHANT SHIPPING

According to the Statistical Bureau of the Russian Ministry of Commerce, the Mercantile Fleet of Russia consists of 3700 vessels as follows:

Class—	No. of Ships.	Total Tonnage.
Motorships	59	130,000 tons net register
Steamships	1,044	513,000 tons net register
Sailing vessels..	2,597	257,000 tons net register

U. S. GOVERNMENT TO ENCOURAGE BUILDING OF WOODEN MOTOR SHIPS

The Shipping Board will encourage a revival of the building of small wooden-ships in this country. In the class of construction to be favored the limit will be 1,000 ton vessels. They may be built for private or foreign account, subject, however, to requisition if military exigencies require them. This decision recently was reached at the regular weekly meeting of the Commissioners of the Shipping Board. The resolution provides:

"That the Board will encourage the building of wooden sailing-vessels or motor-driven vessels, either for American private account, or foreign account, up to 1,000 tons deadweight, provided such buildings receive the approval of the Fleet Corporation as a manufacturing proposition; and provided that the transfer of the flag will be agreed to by the Board when the ship is ready for delivery; it being understood that the vessel will be free of requisition during construction. Should military necessity arise, however, the Board reserves its right to commandeer all such vessels; the action herein taken being subject to the concurrence of the Trustees of the Emergency Fleet Corporation."

GEARED TURBINES VERSUS DIESEL-ENGINES FOR TANKERS

According to Captain the Hon. B. C. Pearson, Chairman of the Eagle Oil Transport Company, his firm decided to install geared-turbines and oil-fired boilers in the new tankers that they now have under construction. This decision, he estimated, was arrived at after careful consideration between the Company's technical staff and various builders, and was only due to the large size and high horse-power of these ships precluding the adoption of Diesel-type internal-combustion heavy-oil engines, ther vessels being of 18,000 tons deadweight carrying capacity, or several thousand tons larger than America's biggest oil tankers.

Here is a case where a prominent shipowner admits that the marine Diesel heavy-oil engine is very desirable; but cannot utilize it because it has not been developed to sufficiently high power, and because their vessels are of very large capacity. Capt. Pearson frankly stated "there could be no doubt that at no distant date internal-combustion-engines of the Diesel-type would be the established practice for marine purposes.

Despite the enormous advantages to be gained, and financial savings made, we have yet to see a combination of American shipowners and oil-companies forming together and subscribing several million dollars for the purpose of assisting domestic engine builders to develop and perfect the marine crude oil engine in high powers.

As we write we have before us extracts from the financial report of one of the largest shipowning companies in the United States, namely the Atlantic, Gulf & West Indies Steamship Co., whose shares earned $59.57 each during 1917, the net profits being $9,647,513.00, or an increase of $1,412,842.00 over the previous year. Consequently they have had to pay some $6,000,000.00 in excess profits taxes. Yet the officers of this company do not seem to realize the enormous advantages that ultimately would acrue if some of this money had been used for the purpose of motorship and oil-engine experimenting.

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Wooden Auxiliary Schooners

By FRIDTJOF BRYDE

The following article by Fridtjof Bryde, manager of Fridtjof Bryde & Co., Ltd., shipowners of Christiania, Norway, is a defense of the wooden motor auxiliaries. Mr. Bryde recognizes the faults that exist with this type of cargo carrier, nevertheless he is firm in his belief that under proper working conditions and given a proper chance the oil-engined vessel will be found to be a success. In the article he brings out some of the difficulties that have arisen in the wooden shipbuilding program and has met them and has offered suggestions which coming from a man of his experience should bear considerable weight. —EDITOR.

THERE has been much talk and much criticism in connection with the building of wooden auxiliary schooners. Making use of the space kindly offered me by the editor of "Motorship," I venture to make a few remarks from a commercial point of view.

From our own personal experience we know what splendid service the woodn sailing vessels rendered in olden days. As an example, in the eighties, one of these ships, a clipper of 2800 gross tons, carrying 27,000 barrels of petroleum, made a record trip from New York to Antwerp and from Quebec to London in twelve days. At this time, on account of the immense shortage of tonnage, wooden ships are again called upon, and the scheme of installing reliable crude oil engines in sailing vessels has been carried out. These engines have given very good results in steel square riggers as well as steel fore and aft schooners, and should therefore easily be advantageously adopted for the wooden schooners.

This combination, however, points to a matter which is of utter importance, namely—**workmanship.** Owing to the immense demand for tonnage, wooden shipyards have been established in large numbers all over our seacoast and the work has been carried on in many cases by non-competent and in some cases unreliable men. This circumstance has caused more pain than many seem to realize. As a result the ships built show not only inferior work, because of the use of green timber, bad rigging and poor installation of engines, etc., but the immediate result has been that many yards have gone into bankruptcy, thereby causing incalculable delay, increased cost of the vessels being built, and various other troubles.

It seems that the banks in certain localities have not attempted to use the necessary conservative judgment which eventually would avoid such calamaties, and, too, the middlemen have been unscrupulous and incompetent and have charged exorbitant commissions. It thus seems necessary that the U. S. Government, through its various agencies, should introduce a most careful control of the establishment of yards. In many cases, where foreign enterprise, such as Scandinavian, has been left to the judgment of their agents in this country, severe losses have been the result, owing to the circumstances mentioned above. Personally the writer knows of not less than three yards which went into bankruptcy proceedings, being absolutely unable to fulfill their contracts. The foreign owners have thus been forced to take the yards over and complete the vessels at a considerably increased cost.

As pointed out before, there is no reason why the wooden auxiliary schooners should not prove a first-rate useful cargo vessel. Other circumstances should, however, be borne in mind, such as if green timber is used, as is the case in many of the vessels, it would be advisable for the first two or three years to employ these vessels in a suitable trade, such as the Pacific trade and the Eastern trade, and I look upon the wooden schooners to make the most useful tonnage in the trade between Pacific ports and Australia, Far East, Hawaiian Islands, etc., preferably, though, in a trade where they do not have to cross the equator. They will thus be able to release for the transatlantic trade the tonnage so badly required—fast-going steamers.

The auxiliary wooden schooner possesses many advantages, such as comparatively small crew; they are useful in most kinds of weather, and are economical in operation. As regards the latter statement, however, much depends upon the rate of insurance, and there is another point, and that is that the insurance companies will have to alter their opinion of the quality of these vessels. Practical results obtained in the trade will soon prove the efficiency of the wooden schooners, which no doubt will form one of the great helping factors in winning this war.

GREAT BRITAIN AND DIESEL-DRIVEN SUBMARINE DESTROYERS

Referring to some remarks made in the March issue of MOTORSHIP regarding a British Diesel-driven (presumably) submarine-destroyer, Arms-and-the-Man, who is one of the most practical of the English war critics, states in the June 1st issue of *Winning Post:*

. . . "We think our contemporary may accept without reserve the assurance that the British naval constructor has not been standing still." . . . Continuing, Arms-and-the-Man says: "The destroyer type of vessel, so far as sea-keeping capacity is concerned, is the vessel we need for convoy purposes; but, whilst engaged on convoy work a destroyer's torpedoes are not needed; in other words, we need a fast seaworthy vessel, sufficiently heavily gunned to take care of herself in an engagement with the German submersible-cruiser. She will probably have to be a vessel from 150 feet to 200 feet in length, with a better speed than the best class of submarines, and she could in such conditions be far more heavily gunned. A 6-inch weapon is by no means impossible, and would be preferable from many points of view to the 4-7. That is to say, that this vessel would be a bit shorter ship than our T.B.D.s of the 'Acasta,' 'Firedrake,' etc., class, and would mount fewer but heavier guns. She would need no torpedo tubes, and her speed need not be as great, for anything able to go a bit over 20 knots would do. She would need engines something between 1,000 b.h.p. and 2,000 b.h.p., and the ideal engine would unquestionably be the high-speed Diesel, such as is used in the big submarine."

"It is obvious," says Arms-and-the-Man, "that camouflage is one of the main considerations in this class of vessel, and Diesel power would be a tremendous aid to this end. Our constructors have not, as we have above observed, been standing still or idling."

THE AEROPLANE VERSUS THE SUBMARINE

It has been officially stated that the destroyer is the most effective weapon against the submarine; but many unofficial authorities have strongly advocated the use of aeroplane and seaplanes to fight the U-boats. Undoubtedly, seaplanes and aeroplanes make fine "eyes" for the destroyers, especially, if operating from a depot-ship several hundred miles off shore. However, whether they can be successfully used for attacking submarines at sea, under all conditions of weather, still awaits definite "official" statements. Various stories of successful sinkings accomplished by aeroplanes have been published in the daily press; but apparently, such have been unofficial or semi-official.

"The British official statement concerning the Naval Air Offensive against the 'Goeben' in the Eastern Mediterranean," says an English authority on aeroplanes, "provides additional evidence of the futility of bomb dropping upon defended targets of small area, and points clearly to the need for a wider use of the torpedo-carrying seaplane.

"The 'Goeben' is 610 feet long and 97 feet in beam. It is officially admitted that 276 flights have been made against the 'Goeben,' which may reasonably be presumed to represent the dropping of some 1,000 bombs. Now, 'at least' sixteen direct hits out of such a number does not encourage one to recommend the continuation of bomb dropping as an effective form of offensive against armed enemy shipping. Had the 'Goeben' been underway the target would have been even more difficult. On the other hand, one torpedo dropped into the sea broadside on would probably have done the trick."

An Ansaldo-built Italian patrol-boat, the "M. A. S. 15," equipped with a bow torpedo-tube. She is driven by American-built Sterling gasoline motors. For many purposes the Italian Navy have found these craft very valuable, one of them recently torpedoed two Austrian battleships.

AMERICAN SHIPS SUNK DURING WAR

Up to March 31st last, no fewer than 84 American merchant ships have been sunk by submarines, mines, etc. These include nine tankers, 37 sailing-ships, and two motor-auxiliary sailing-ships; but no full-powered motorships. Seven of the sailing-ships were sunk by a raider in the Pacific Ocean.

MR. LISLE'S TESTIMONY—A CORRECTION

A very curious typographical error was made in our April issue in connection with Mr. Lisle's testimony before the Senate Committee on Commerce. On page 18, the top part of the second column above the illustration belongs between the 4th and 5th lines of the second column below the illustration. And the top part of the 3rd column on the same page belongs between the 8th and 9th lines of the 3rd column below the illustration.

LARGE WINCH CONTRACT

IN connection with the plans for the immediate enlargement of the plant of the Vulcan Manufacturing Company of Seattle, Wash., recently acquired by the Frank Waterhouse Company of the same city, it has become known that this firm has received a contract from the Skinner & Eddy Shipbuilding Corporation, one of the most successful shipbuilding companies in the country, to furnish 50 anchor winches and 500 cargo winches with which to equip the large number of new ships to be built by that company for ships of the Emergency Fleet.

The contract is one of the largest ever let to a Pacific Coast concern engaged in the manufacturing of auxiliary deck and hoisting machinery for deep-sea vessels and the Vulcan company is preparing to turn out the work as rapidly as the shipbuilding company requires the equipment.

Immediate steps are being taken towards increasing the facilities of the plant and under the direction of R. J. Church, the general manager the work is now going ahead very quickly. The new contracts with Skinner & Eddy, together with business in hand, insures the capacity operation of the plant for some time to come. Shortly we will illustrate one of the standard anchor windlass manufactured by this company, of which more than 100 have already been built and installed on vessels now on the high seas.

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The Lyons-Atlas-V. D.V. Oil Engine

A Moderate-Powered Marine Heavy-Oil Motor of Modern Design

PROBABLY there is no such thing as a true semi-Diesel engine, although in our issue of February, 1917, we described an American marine oil-engine operating on a cycle that we suggested may be designated "semi-Diesel," because it more closely resembled the Diesel cycle than any surface-ignition engine, and that the term surface-ignition did not correctly describe its method of combustion.

This particular patented cycle of operation is quite distinct from other cycles, and has been adopted by about twenty engineering companies throughout the United States, several of whom are now engaged in developing and perfecting a marine motor; but, in practically every instance the general mechanical features of the engines have been designed by the individual firms.

An engine of this principle has been designed and built by the Lyons Atlas Company of Indianapolis, who have had very considerable and valued experience in the construction of marine and stationary oil engines. This model is known by them as the type V.D.V., and is built in 25 bhp., 50 bhp., 75 bhp. and 100 bhp. units, so meets a serious demand for a good, simple and moderate powered heavy-oil engine for fishing-vessels, towboats, ferry-craft, sailing ships, naval picket-boats, and ship's auxiliary machinery.

Before describing the new 100 bhp. Lyons Atlas V.D.V. engine, it is well worth referring to the careful study of fuel available in different territories that has been made by the designers, so that local conditions are arranged for before the engine leaves the builder's hands. Generally speaking, the desirable fuel-oils for this engine are to be found in the wide range of low-grade petroleum and products which are generally recognized as suitable fuels for heavy-oil engines varying from clean crude and fuel-oils to engine distillate and kerosene, of such characteristics as to be thoroughly combustible and sufficiently liquid at ordinary temperature to flow freely to the primary cup by gravity under a head of two feet.

Engines for the Pacific Coast are regularly adjusted for Calol and Diesol, both approximately 24° Baume gravity, 27+, which ranges upward from 27°, and "Tops" which are about 38° Baume. All of these are well-known products of California asphaltum base crude, and are used extensively in California, Oregon, Washington and other Western States.

Engines for other parts of the United States and foreign countries are regularly adjusted for kerosene, solar-oil and other low-priced paraffine base distillates and fuel-oils of 28° and higher Baume gravity, which are sold under various trade names in different localities.

As regards consumption, the makers give definite guarantees that it will not exceed the following hourly quantities per brake horsepower, based upon a minimum net or effective heat content of 18,500 British Thermal Units per pound, when developing full rated capacity and the following fractional loads, respectively, to wit:

At full loads, 0.60 pound (about one-twelfth gallon).

At three-quarter loads, 0.66 pound (about one-eleventh gallon).

At one-half load, 0.78 pound (about one-tenth gallon).

But in actual practice we are sure that these consumption figures are very considerably lowered. For the cycle of operations the four-stroke principle has been adopted, and, as with the Diesel cycle, heat for combustion of the fuel is generated by compressing air in the working cylinder to about 450 lbs. per sq. inch; but the method of introducing the oil fuel into this heated air is quite different, as there is no compressed-air used for injection. It is claimed that just as much, if not more, heat units are gotten out of the fuel by the method adopted.

Fixed in the cylinder head and partly protruding inside the combustion chamber is a small cup or container, and oil fuel is fed by gravity into this cup via a needle-valve and the fuel valve, these valves being open on the suction stroke, the needle-valve regulating the quantity of oil.

In the walls of the cup are a number of fine holes, and towards the end of the compression stroke the highly-heated air is forced through these holes; also the walls of the cup are heated, with the result that part of the fuel inside the cup is vaporized.

Just as the piston reaches the top of the stroke, the temperature becomes sufficiently high to ignite the vapor formed, causing a miniature "explosion" inside the cup. The force of this "explosion" is greater than tht cylinder compression, consequently the still fluid-oil remaining is sprayed through the holes into the cylinder, where the main combustion instantly occurs, and the piston is driven down on its power stroke.

On the next up-stroke of the piston, the burned gases are scavenged-out through the exhaust-valve, and on the following down-stroke clean atmospheric air is drawn in, the suction also drawing the fuel into the cup as before, and the previous cycle of operations is repeated. Hence, no electrical or hot-bulb ignition device is required to assist the combustion.

The Lyons-Atlas Company themselves describe the cycle of operations in the following manner: "On the first downward stroke, pure air only, and not a gaseous mixture, is drawn into the combustion chamber. Simultaneously a small amount of fuel-oil, proportional to the load and the desired speed, as accurately determined by the governor, is delivered into a primary cup located inside of the combustion chamber and attached to the cylinder head."

"On the return stroke, with all valves closed, the air in the combustion chamber is compressed to a pressure of about 450 pounds per square inch, which increases its temperature to about 900° Fahrenheit.

"As the piston approaches the cylinder head, and the temperature of the entrapped air, as the result of compression, rises above a certain intermediate degree, the lighter hydro-carbons in the fuel-oil in the primary cup are vaporized, exactly the same as in a still at an oil refinery. This vapor immediately ignites and expands to greatly increased volume at almost the exact moment that the piston reaches the end of the compression stroke, and is about to start downward on the power stroke.

"The amount of vapor thus burned is small, and the effect upon the pressure in the combustion chamber, as shown by indicator diagrams, is scarcely perceptible, but its force inside of the cup is sufficient to separate the remaining liquid into tiny particles and drive it in the form of a fine mist through small holes in the walls of the primary cup into the combustion chamber. There the minute atoms encounter the incandescent heat due to compression, take fire and are burned thoroughly during practically the entire power stroke of the piston, remarkably efficient combustion being supported by the oxygen in the charge of pure air admitted on the previous downward or suction stroke.

"The burning of the fuel causes the air in the combustion chamber to expand to many times its normal volume under compression, and this constitutes the propelling force which drives the piston downward on what is obviously termed the power stroke.

We now come to the mechanical side of the design. The cylinders are carried on steel columns, extending from the base of the cylinder to the bed-plates, and as the bottom boxes that carry the lower halves of the main bearing brasses are concentric, they can be rolled out and replaced with the shaft in place. The shaft itself can be rolled out directly in front of the engine by removing the front tension rods extending from the cylinder heads to the bed-plates, and without requiring any space longitudinally beyond that occupied by the engine.

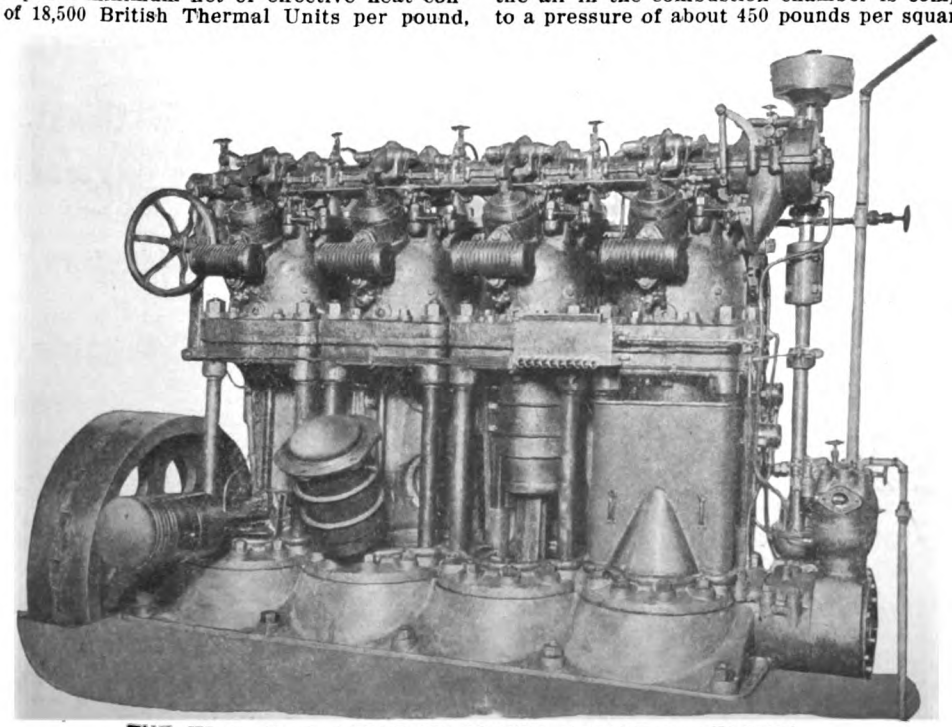
Reference to the illustration will show that the cylinder and cylinder head are combined in one casting, long enough inside to equal the travel of the piston. This construction obviates the necessity for a joint in the high-compression space. Further, by avoiding the solid reinforcing material required at such joints, the cooling effect of the circulating water is improved and the expansion of the metal should be uniform.

The skirt, or lower part of the cylinder, is detachable, as in the well-known Werkspoor submarine and gunboat engine designs, so that the piston and skirt can be rolled forward to a position which affords the most convenient inspection of the piston and rings, by simply removing the bolts holding the skirt to the cylinder and head casting and placing the crank on the bottom center, without disturbing or disconnecting any other part of the engine. This operation consumes very little time, and is of great advantage where quick inspection and the least possible interruption to service is desired.

The cam shaft is located directly over the center line of the engine, midway between the inlet and exhaust valves which are disposed angularly, 60° apart. It runs in a removable die-cast reservoir for the oil in which the cams and cam rollers revolve. It is driven by gears from the crank shaft through the vertical drive shaft, which also carries the governor, the latter being of the well-known Jahns type.

Forced-feed lubrication under pressure from a rotary pump is provided for the crank and cam-shaft bearings; the crank pins, piston pins and all gears. After passing through the bearings, the surplus oil gravitates into a receiver, whence it is pumped into the system repeatedly through a cooler, which restores it to atmospheric temperature and viscosity, meanwhile going through two strainers, one coarse and one fine, which thoroughly cleans the oil by intercepting the solid particles of foreign matter. The small lever pins are fitted with compression grease cups. For the cylinders there is a mechanically-driven force-feed cylinder lubricator of standard make, with two separate feeds to each cylinder.

The air compressor serves only to provide starting air pressure at 250 lbs. per sq. inch. It is single-stage water cooled, and is built into the engine as in integral part, being mounted on the bed-plate and driven by an arm on one end of the crank shaft.



THE 100 B. H. P. LYONS-ATLAS-VDV MARINE OIL-ENGINE.
Showing successively the arrangements for access to the pistons and rings. No. 2 front frame housing removed; No. 3 crank on bottom center, skirt section of cylinder disconnected and swung outward with piston and connecting rod; No. 4 skirt removed by slipping over the piston and rings.

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Oil-Engine Sprayers or Pulverizers

No. 2

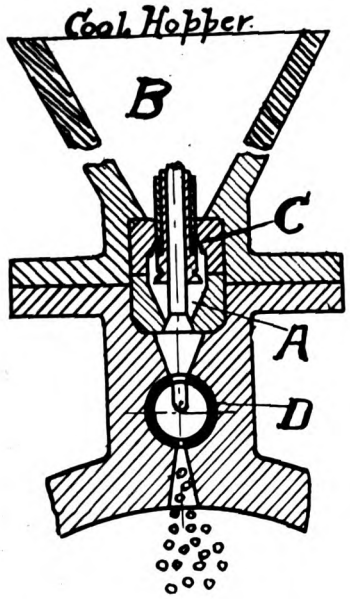
(*Continued from the May issue*)

By A. H. GOLDINGHAM and C. T. O'BRIEN

IN the previous article we outlined the development of the low-pressure oil-engine sprayer. Various devices employed in different designs were described and illustrated, and reference was made to the results obtained with each type, while some disadvantages were pointed out.

With the advent of the Diesel engine in 1892, compression pressures of 600 to 800 pounds were utilized as compared with compression obtaining in oil engines previous to that date of less than 100 pounds. The fuel was also to be injected against the maximum pressure of compression and partial combustion, and combined with compressed air at 1,000 to 1,200 pounds pressure instead of the previous practice of fuel-injection against atmospheric pressure. This higher range of pressures, and injection of the fuel after compression was practically completed, necessitated entirely new designs of sprayers or pulverizers instead of those of comparatively simple construction previously described.

When the Diesel engine was first invented it was thought possible to use powdered coal in the cylinder of such an engine, and the device which



SPRAY VALVE, COAL.
DIESEL ORIGINAL.
FIG. 10

the late Dr. Rudolf Diesel proposed to employ to introduce the powdered coal into the cylinders is shown at Fig. 10.[1] It is now of interest from a historical rather than from a mechanical standpoint, as we believe it was never successfully operated. [It was not developed to a point where it attained commercial success—Editor.] Dr. Diesel proposed that the powdered coal dust should gravitate to the Hopper B. The amount of fuel entering the cylinder was that which filled the recess A in the part C, which was to be moved up and down, and, being provided with two valves, the supply of coal dust was only allowed to enter the combustion space at the correct period of entry. Below was placed a revolving disc D

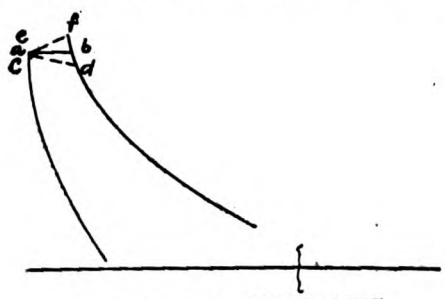


FIG. 11. FUEL INLET LINE

suitably slotted as shown. This was to allow at each revolution the coal dust to "gradually and continuously" be injected into the combustion space.

In Fig. 4 we illustrated the various fuel-injection periods of the cylinders of different engines built in recent years and the period of fuel-injection, of the Diesel engine is also shown. The requirements of the system theoretically laid down by Dr. Diesel, but not altogether attained in practice, were as follows:[2]

"Gradual introduction of the pulverized combustible into the compressed and heated air during part of the stroke of the piston and in such a way that combustion produces no increase in temperature of the gases. Hence, "the combustion curve obtained is as nearly as possible isothermal. After ignition, combustion is regulated by external mechanism; the right proportions are established between the pressures, volumes and temptratures of the gases."

The functions of the fuel inlet, sprayer, or pulverizer, are "first that of a valve to introduce the fuel-oil into the cylinders at the correct moment, and secondly, that of a sprayer to divide the fuel into minute particles."[3]

The ideal fuel-injection would fulfil the following requirements:

(a) The velocity of the injection should be such that it is proportional to the speed of the piston at all times.

(b) The atomization of the particles of liquid fuel should be complete, allowing the maximum surface of such particles to be exposed to and combined with the oxygen of the air.

(c) The duration of the fuel-injection should be proportional to the amount of load on the engine.

If the first requirement was fulfilled the constant pressure line a b in Fig. 11 would be horizontal, but in practice it frequently, if not always, falls either below, as indicated in an exaggerated form at c d, or is found slightly above horizontal line, as seen at e f, but with partial or complete rounding of the angles of the diagrams, which will be readily observed on most indicator cards.

In an excellent series of articles published by an English contemporary on "Fuel Injection," by "Comus," the question of atomization of the fuel is discussed at length.[4] It is there pointed out that three zones exist through which the particles of fuel pass when emerging from the pulverizer into the combustion space corresponding with the three different stages in the process of combustion.

In the first zone, the fuel is in a finely atomized spray, where each particle of fuel becomes reduced in size as it passes further away from the nozzle. In the second zone, complete vaporization of the particles takes place, while in the third zone, combustion or burning of the completely vaporized particle takes place. The various temperatures and velocities of these three zones are probably in relation to each other somewhat as that indicated in Fig. 12. This is a suggestion rather than an accurate presentation of

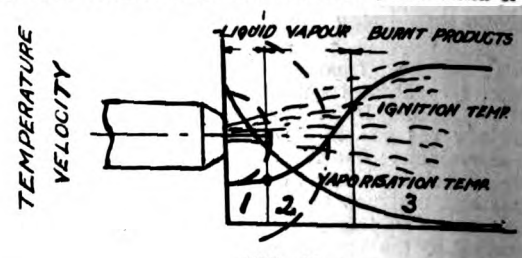


FIG. 12

the relation of the temperatures and velocities existing in the three different zones referred to.

A general type of sprayer, or pulverizer, is illustrated at Fig. 13. It consists of a steel valve-stem with conical valve seat around which are

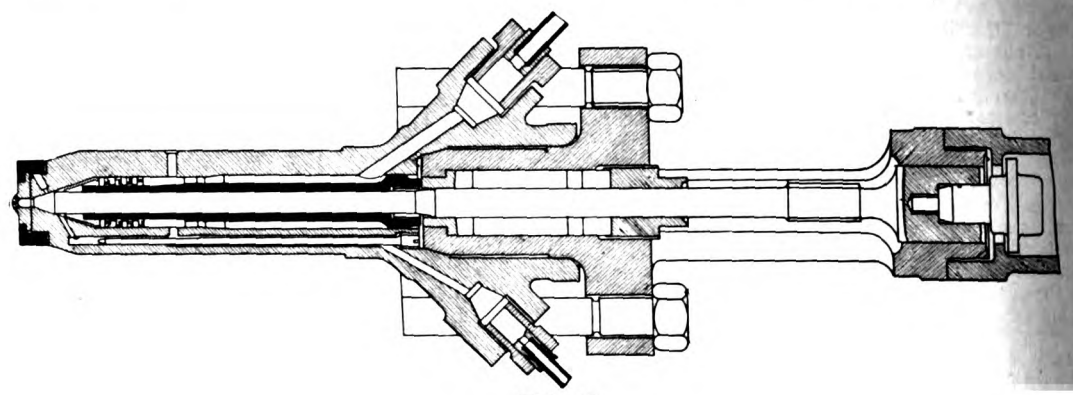


FIG. 15

placed a series of perforated washers. The fuel from the fuel pump is delivered to the chamber above these washers where it is mingled with compressed air at 50 to 70 atmospheres, 700 to 1,000 lbs. at the correct period for fuel-injection into the combustion space (viz., about 8° before the crankpin reaches the inner dead center and for about 30° of the circle after the dead center is passed). The valve is lifted from its seat by the cam and rocker arm, as illustrated in Fig. 16, and the pulverized fuel and air is injected into the cylinder through the steel nozzle.

There are several modified designs or different types of sprayers, four of which will be specially described. They are: 1.—The Hesselman; 2.—The Lietzenmeyer; 3.—The Sabáthè; 4.—The Deutz.

The Hesselman device is found in the Polar Swedish engine, and is manufactured in the United States by the well-known McIntosh Seymour Corp. It will be described and illustrated in the following section of this article.

The Lietzenmeyer or "open" type is found in the Dingler, Koering and other horizontal Diesel engines in Europe, and in the Snow horizontal Diesel engine built in this country, and is shown in Fig. 14. The feature of this design is the elimination of the pressure against which (in other types) the fuel-injection pump works. In this way the power absorbed is reduced, and the

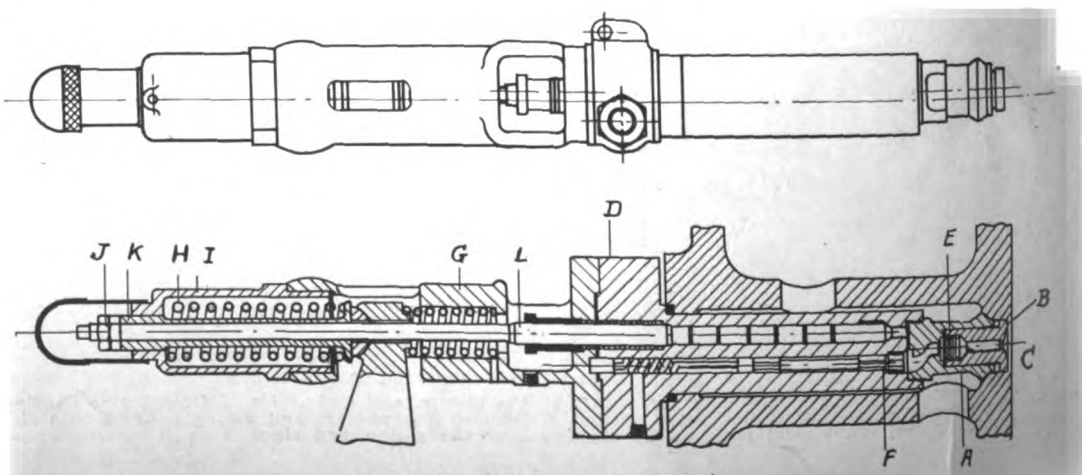


FIG. 14. SNOW SPRAY VALVE

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tendency for leakage past the packing and glands of the pump or sprayer are avoided.

The Snow type of sprayer or pulverizer shown in section at Fig. 14 has its operation as follows: The fuel pump forces the proper quantity of oil through the spray valve, and it is then deposited

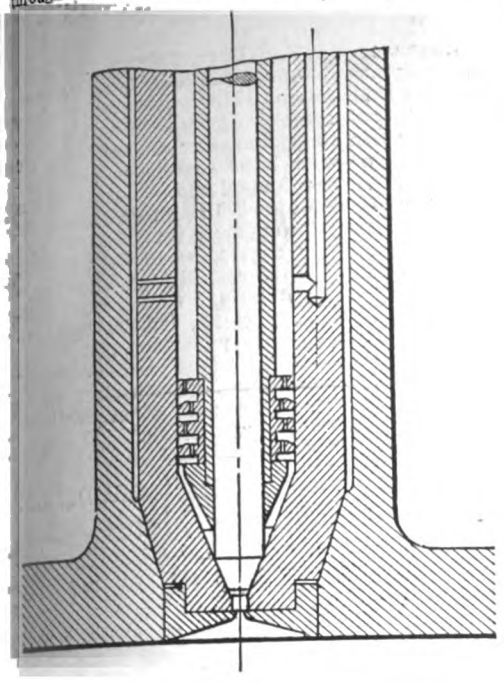

FIG. 13

in the chamber A shown in cross section. It remains in this chamber until the mechanically operated air valve is opened, allowing compressed air to enter this fuel chamber; thus the oil is carried along through the atomizing nozzle plates B, and discharged through the spray tip and nozzle C. The nozzle plates are a series of flat discs with grooves cut on their periphery, and locked on to a centering tube carried by the first plate.

The spray valve body D has the spray nozzle A screwed into it. This piece is locked by the centering pin E, so that the relation of the nozzle to the body is always the same; thus the oil chamber will be always at the lower side. Fuel is admitted as shown in the valve body, and passes along to the nozzle through the oil passage and check valve F. This prevents leaking back again. Air enters at the top of the flange, and passes parallel to the spray valve stem until it enters the chamber at the valve seat.

The spring guide is made in two parts, with the main guide G centering on the spray valve body. The spray valve spring H is carried in a cap I, which screws into the spring guide. The force of the spring is transmitted through the lock nuts J and distance piece K to the spray steam L. The stem end is squared so that it may be ground in without disturbance of other parts.

The Deutz sprayer is shown in section at Fig. 15.[3] It is provided with two fuel inlet-passages connected to two separate supply pumps. This type is designed for using the heavier crude oils and tar oils. In operation a small amount of the lighter fuel (about 5%) first enters by the passage leading to the chamber closest to the valve seat, while the heavier fuel or tar oil passes only to the main injection chamber placed further away from the valve seat and nozzle. When the valve is lifted from its seat, the lighter fuel first passes through the nozzle, and first entering the combustion chamber is readily ignited. In this way the temperature in the combustion space is raised and produces more readily, the proper combustion of the heavier or tar oil which follows:

In Fig. 16 is shown the M.A.N. sprayer which is of a somewhat similar description as the design last described.

The De La Vergne "FH" hot-furnace type of spray-valve is shown at Fig. 17. Compressed-air at a pressure of about 1,000 lbs. enters as shown in the illustration. The oil also at the same time is supplied through the opening indicated on Fig. 17. Air and oil are thoroughly mixed by passing through the fine channels of the atomizer B before being discharged through the spray nozzle C, when the spray valve stem D is mechanically opened.

The spray nozzle C in this design varies from the usual Diesel nozzle. In the Diesel nozzle, a flare or cone shape of large angle is used, which spreads the oil spray in the largest volume of the combustion space possible. In this type a hot-

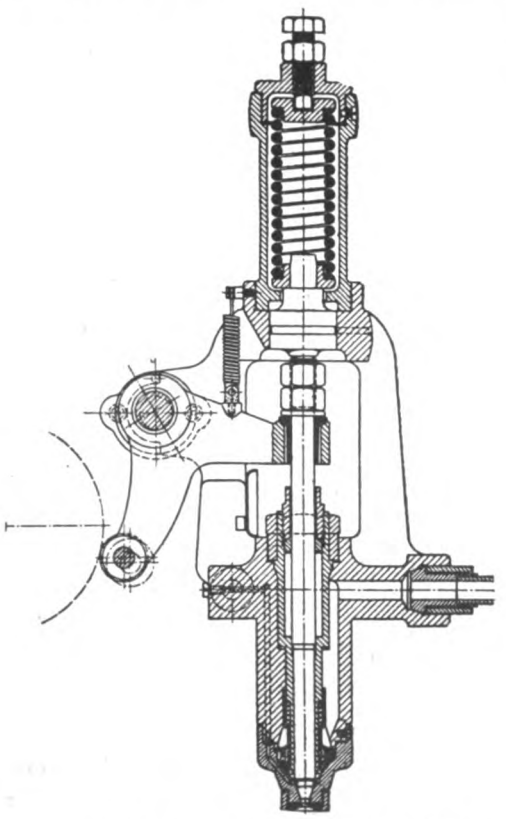

FIG. 16. M.A.N. SPRAY VALVE

chamber of about one-quarter the volume of the combustion space is situated directly opposite the spray-valve. The spray must be entirely discharged into this vaporizing chamber, and should not be spread throughout the combustion chamber, as is in the Diesel type. The stuffing box E is made separately from the valve body, and is a ground fit on to the valve body.

The spray-valve body and stuffing-box are forced together by means of the spring guide F. The

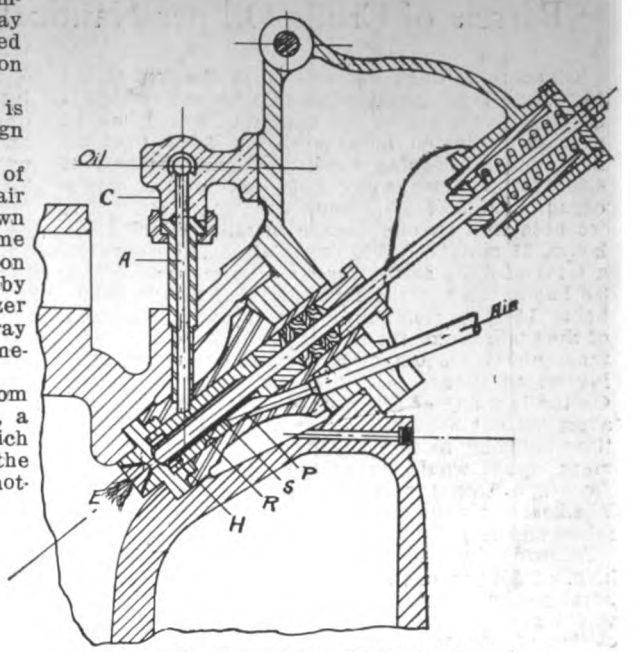

FIG. 18.—ATLAS SPRAY VALVE

guide carries the fulcrum pin G on which the opening lever acts. The spring H is placed between the two collars I, which are seated on the spray steam, and can be adjusted by means of the lock nuts J and distance piece K.

The Atlas-Diesel sprayer is shown in section at Fig. 18.[6] It is located on an angle and is on the side of the cylinder cover. This arrangement allows proper circulation of the cooling water, brings the fuel spray near the center of the combustion space, and permits direct operation of the valve stem by the bell crank shown in the illustration.

Fuel-oil enters through the passage A, and flows into the space R, from where it is forced through a series of small holes into the annular space S, which space is in communication through the slot P, with the injection air supply.

As soon as the spray valve is opened, the injection air and oil are forced through a number of holes E and through channels H, which act as the injector nozzle, into the combustion chamber.

C is a valve for filling the oil pipe, before the engine is started up.

This spray valve is very compact. The stuffing box is of sufficient length, and the spring allows softness of closing. The spring tension can be varied by means of the spring cap.

(To be continued)

1. Rational heat motor by Rudolph Diesel, Page 60.
2. Rational heat motor by Rudolph Diesel, Page 82.
3. Diesel engines by G. Supino, Page 130.
4. "Internal Combustion Engineering," June, 1914.
5. Marine and stationary Diesel engines, A. E. Goldingham, Page 44-133.
6. A. S. M. E. Transactions, 1915.

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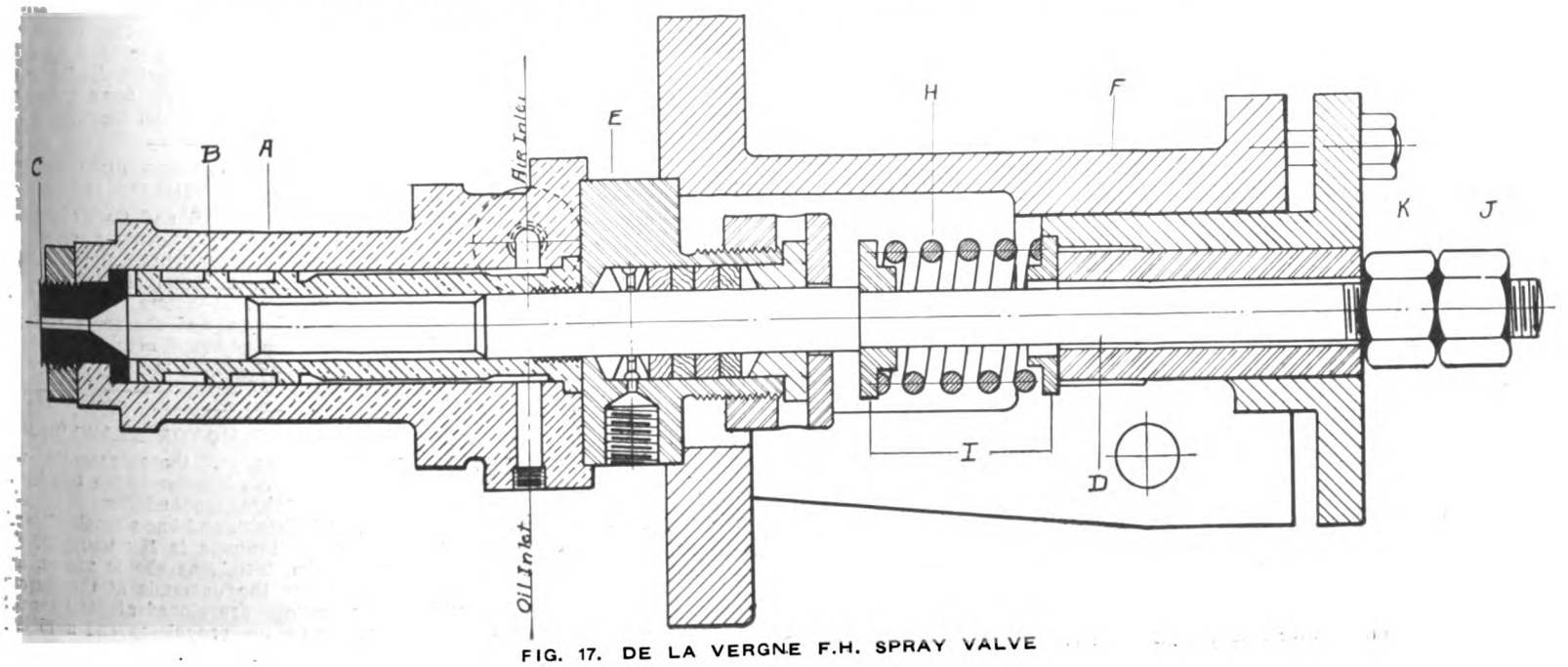

FIG. 17. DE LA VERGNE F.H. SPRAY VALVE

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Extracts from a Motorship's Log

2,500 Tons of Actual Cargo Carried at 9 Knots Average Speed on a Fuel-Consumption of 0.167 Barrels of Crude Oil per Nautical Mile. Or, Over Eleven Thousand Miles on 200 Tons of Fuel

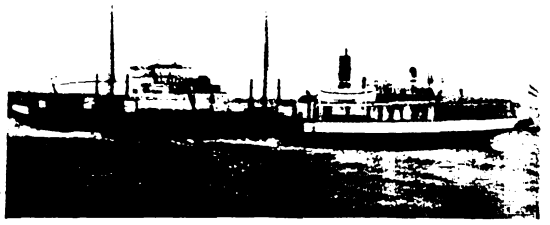
Glancing through extracts from the log of the four-cycle type Diesel motorship "Juno," which is a single-screw vessel, the engine of which has an average indicated horse-power of 1,323 to 1,330 h. p. under sea-going conditions, and which is of 4,200 tons displacement, 2,500 tons actual cargo-capacity, and of 2,675 tons deadweight capacity, we note that on one voyage in mid-winter of 411 hours, 21 minutes (17⅛ days) at sea, she covered a total of 3,638 nautical-miles at a mean speed of 8.8 knots, the average revolutions of the propeller being 114½ per minute. The total consumption of the main motor for this entire voyage was 70.87 tons (about 496 barrels), the auxiliaries consuming an additional 16.15 tons (about 113 barrels). On the last day of the voyage (8 hrs. 30 min.) she averaged but 6 knots as this apparently included time entering harbor and docking, otherwise her mean speed would have been higher. Her best day's speed on that voyage averaged 9.64 knots. The best day's run on this voyage was 229 nautical miles and the engine speed 120 revs. per minute.

Allowing the usual deduction from the indicated h. p. of 25 per cent, the mean brake (or shaft) horse-power developed was 998 b. h. p., which would give an average consumption to the main engine of 0.386 lbs. per brake-horse-power, or 0.29 per indicated-horse-power, not including auxiliaries, which as noted above was only 6.65 barrels per day. The waste exhaust-gases from the main-engine principally were used to fire the auxiliary donkey-boiler, which supplied steam to the steering-gear. This shaft-horse-power consumption is exceptionally low, even for an internal-combustion-engine. In calculating the shaft-horse-power the owners conservatively deduct 30% from the indicated horse-power; but our own figure of 25% probably is nearer correct.

On a different round-voyage lasting about 52 days she averaged 4.92 tons (35 barrels) of fuel-oil, including auxiliaries, per 24-hour day when at sea, or 4.14 tons (29 barrels) per day for the main engines only. The total consumption including in port and all auxiliaries was 195.37 tons, (or about 1,367 barrels). During the time at sea the main engine consumed a total of 148 tons (1,036 barrels).

Taking the figures of the first mentioned voyage into consideration her daily mileage (if an average of only 8.8 knots be taken) is 211.2 nautical miles, and her daily fuel-consumption is 35.2 barrels, which gives an hourly consumption of 1.48 barrels. This, with fuel-oil at $1.50 per barrel, means a fuel-bill of $2.22 per hour, or 25c per nautical mile. As she carries 2,500 tons of actual cargo in her holds the fuel cost per ton-mile is **$0.001**, that is to say one thousandth part of a dollar.

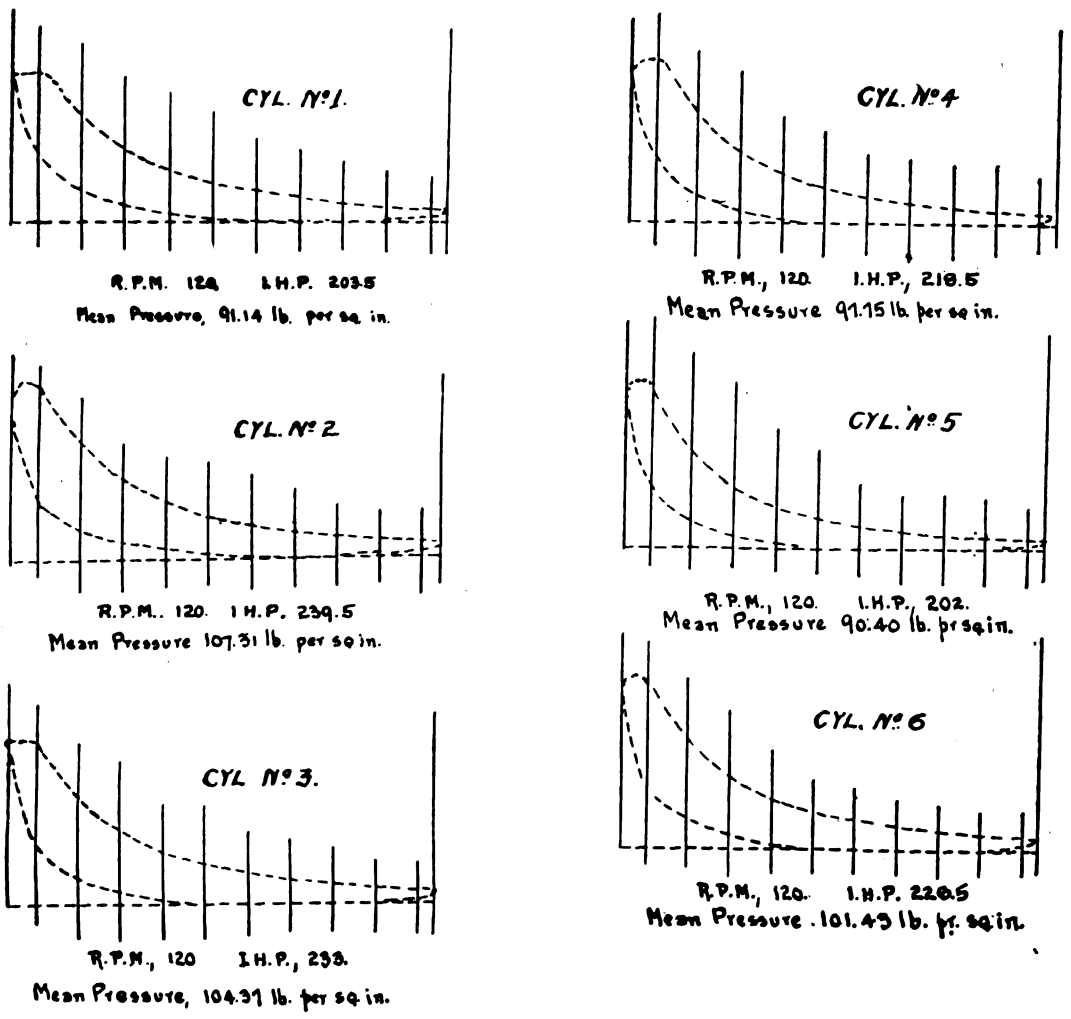
To make the matter more simple it may be said that the total fuel-consumption is 0.167 barrels per nautical-mile, which is remarkably low compared with a steamer. The "Juno" is a tanker with her engines aft. She has a length of 258 ft., with a 45-ft. breadth and 18½ ft. draught, and is registered with Lloyds. Some interesting technical information will be obtained from the following:



The motorship "Juno". Note the absence of smoke! Were she a coal-burning steamer, the smoke would reveal her presence to a U-boat many miles away.

On the second voyage quoted, the indicator-cards showed a mean-pressure of 101.3 lbs. per sq. inch, the total i. h. p. being 1,323 h. p. from six cylinders, each 22 ins. bore by 39⅜ ins. stroke at 120 r. p. m. The pressure of the fuel-injection-air used was 852.6 lbs. per sq. inch, and the cylinder-air-compression 410 lbs. per sq. inch. The temperature of the exhaust-gases was 698 Degs. Fahr., and the cooling-water was 110 Degs. Fahr. at the outlet. The engine, a Werkspoor-Diesel, is of the cross-head type, and weighs 122 tons (with a beam-lever driven air-compressor, and beam-driven bilge, cooling and lubricating pumps) or 110 tons bare. The maximum power is 1,100 shaft h. p., or 1,500 indicated h. p. The fuel-oil used on these voyages was a Borneo crude of 200 Degs. Fahr. flash-point called Tarakan, the engineer using Solar-oil for a short period every day, so as to clean the fuel-injection valves of tar and dirt deposited by the heavier oil. The piston-rings were ordinary Ramsbottom rings ⅜ins. by ½ in., and the engine governor was of the ordinary Aspinall type.

The "Juno" recently arrived at the Dutch East Indies, and the Marine Superintendent of the owners is preparing an account of her latest voyage especially for "Motorship."


CYL. N°1.
R.P.M. 128 I.H.P. 203.5
Mean Pressure, 91.14 lb. per sq in.
CYL. N°4
R.P.M., 120. I.H.P., 218.5
Mean Pressure 91.15 lb. per sq in.
CYL. N°2
R.P.M.. 120. I.H.P. 239.5
Mean Pressure 107.31 lb. per sq in.
CYL. N°5
R.P.M., 120. I.H.P., 202.
Mean Pressure 90.40 lb. pr sq in.
CYL N°3.
R.P.M., 120 I.H.P., 233.
Mean Pressure, 104.31 lb. per sq in.
CYL. N°6
R.P.M., 120. I.H.P. 220.5
Mean Pressure .101.45 lb. pr. sq in.

Indicator cards taken from the Werkspoor Diesel engine of the "Juno" on the second voyage referred to in accompanying article.

Foreign Naval and Commercial Motorship Notes

THE LESSNER-DIESEL ENGINE

Some of the Russian submarines and gunboats are fitted with Lessner-Diesel oil-engines, built at Reval. We shall be glad to hear if any of our readers has a photograph of the Lessner marine engine. We are inclined to believe that they have been built under license from Nobels of Petrograd.

AUSTRIAN 600-TON CONCRETE MOTORSHIP

Work on a concrete motorship of 600 tons dwc. has been started at the Easte Osterreichische Eisenbeton Schieffbauunternechmung (First Austrian Ferro-Concrete Shipyard) at Spalato, Austria, where several small concrete vessels already have been completed.

AUSTRIAN DIESEL-DRIVEN TORPEDO DEPOT SHIP

Austria has a large Diesel-driven torpedo depot-ship in service named the "Lussin," completed since the outbreak of war. She is of 1,000 tons and carries four 3-pdr. guns. Her Diesel engines develop 1800 b. h. p. giving her a speed of 14 knots. Her complement consists of 154 officers and men.

ROYAL ITALIAN NAVY TANKERS

When we recently gave illustrations of the Tosi Diesel engined tankers lately built for the Royal Italian Navy, we referred to two others engined by the Fiat-San Giorgio, Ltd. The names of the five vessels, are "Ancheronte," "Cocito," "Flegetonte," "Lete," and "Stige." These vessels are of 1204 tons, and each are driven by one 500 b. h. p. Diesel engine. Many other motor tankers since have been ordered and now are under construction.

WAR LOAN BONDS AS PRIZES

Ansaldo & Co., the Italian motorship builders, have placed at the disposal of the General administration of Aeronautics, the sum of one million lire in bonds of the new (1918) Consolidated 5% War Loan for prizes of not less than 5,000 lire each, to be won by airmen during 1918 who distinguish themselves by bringing down enemy aircraft by means of seaplanes and aeroplanes built by Ansaldo.

RUSSIAN DIESEL-ENGINED SUBMARINE MOTHER-SHIP

Russia, as well as Brazil and Germany has a large Diesel-engined submarine depot, or mother-ship, namely the "Volchow," built at the Putilow yard in 1913. She is a vessel of 2400 tons and has two 600 b. h. p. Diesel motors installed, giving her a speed of 10 knots, and she can raise 1,000 tons by means of the powerful cranes with which she is equipped. Her length is 315′ by 69′ beam by 11¾′ draught.

NEW TYPE OF MOTOR TRAWLER

At Goteborg, Sweden, there recently was launched a new type of motor-driven trawler at the yard of O. Guldbransen and Sons A.B. She is 90 ft. long, 23 ft. beam, and has a moulded depth of 14 ft. Her net tonnage is 150 tons. Of the schooner type, the "Stig", as she is named, has been built to meet the demands of the Bureau Veritas. The engines are placed aft, and consist of a 120 h.p. motor for propulsion and a 15 h.p. motor for auxiliary purposes.

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The Heavy-Oil Engine From a Scientific Standpoint

By Dr. CHAS. E. LUCKE

(Continued from June issue.)

Now the late injection principle of working is highly developed mechanically only in Diesel engines, and herein you see there is a little scientific engineering anomaly. The desired and necessary principle of high compression with delayed injection has been developed in its application to the less promising type of cycle—the Diesel; and the more promising type of cycle, the Otto—that which promises a given fuel consumption half the compression of the Diesel—has been delayed; so that our engines have been highly developed along the less promising line without scarcely any development at all along the more promising line. Do you wonder, then, that with the success that we have had with the less promising, I expect and look forward to much greater success with the more promising field when it vigorously followed up.

We have come now to this point; that after compression we are to introduce the oil, and the oil may be introduced in such a way as to produce an explosion or to burn at substantially constant pressure without explosion. I want to point out to you next the controlling means in use for doing either one of those things or both of them.

First, as to the Diesel: at the time the oil is introduced the temperature of the air is something higher than the ignition temperature—200, 300, 400 and 500 degrees higher than ignition temperature, and, so far in all these engines the oil has been introduced and sprayed by the aid of compressed air. How is the feed of oil controlled so that the rate of combustion shall be just enough to prevent the pressure falling along the re-expansion line but kept substantially constant? That is entirely a matter of spray valve design. If you set yourself the problem—especially those of you who have not worked on this problem—of designing a scheme to squirt oil into a cylinder against 400 or 500 lbs. compression pressure at a graduated rate for 10% to 15% of the stroke, so as to hold the pressure constant, the oil burning as fast as it enters, you will find that you have some little problem on your hands, and I venture to say that eight out of ten men will start with some kind of cam-driven pump. Lovely things, those cams. Now, that won't work at all. The thing that is relied upon is the tendency of the oil to stick to a metal plate. To make that clear, consider the spray Diesel valve with a fairly heavy stem in a casing. Beyond it there is a graduated orifice outlet, which is the spray orifice and is changeable in size to suit the viscosity of the oil. The oil is pumped into the chamber or space between the casing and the valve stem by a pump which has only one duty to perform, and that is measure the amount, it does not time the injection or graduate it. That cannot be done—or it never has been done. I do not think it can be done. The oil, in the ordinary course of events, is put into the spray valve chamber before the injection is wanted, and it will run down to the bottom more or less fast. If the valve be lifted and the oil itself had reached the bottom or valve seat, the first thing to happen after the opening of the heavy oil is a squirt of solid oil with no spraying whatever. In an instant the oil is all out, and, instead of maintaining a graduated combustion for 15% of the stroke we have a lump of oil squirted in without spraying or graduation. There will be a certain amount of combustion but only part will burn, the rest makes a nice little lump of carbon.

Now, to secure graduation of oil feed, all they have done is to stick a lot of plates with holes in them in the space between valve stem and casing. These plates have definite thickness, spacing and drilling, sometimes they are given special forms and surface finish, each designer adopting an air of great mystery about his arrangement, and claiming absurd superiority over his rivals.

All that these things do in the oil chamber, gentlemen, is to provide an extended surface, to which the oil naturally tends to stick. It might be filled with shot and it would no doubt work just the same. The oil is pumped into this chamber and when the valve is pulled open, the oil tends to travel down partly by gravity and partly by the surface frictional influence of the air on the oil. The oil, however, is sticking to that labyrinth surface. The oil chamber is just nothing but a mechanical labyrinth. That is what I call it for the want of a better name. And that is the only means we have that works as a graduator of oil feed, except one. The other one surrounds the stem valve by a sort of venturi tube casing between which and the valve body is formed the oil receiving chamber. These are two holes in the venturi partition between the oil chamber and stem chamber, one from the venturi throat to the bottom of the oil, the other imposing the total air pressure on the oil surface. Whenthe valve is open, the compressed air flowing through impinges on that hole to the surface of the oil and builds up its total pressure, while at the same time the other hole, being at the throat of the venturi, is subjected to a less pressure by the air velocity head, thus developing a lifting tendency on the oil, and we have a regular vacuum flow injector. This action, or the former one of the labyrinth, forms the basis of all the schemes for graduations of feed of oil from the spray valve body to the spray valve nozzle, so that the oil feeds during the required period of time at a more or less steady rate to this nozzle, and it is torn to pieces, or sprayed by the velocity of the air issuing from it. Of course, it is clear that with this arrangement the rate of oil flow, the time of oil feed and the rate of combustion will vary with the viscosity of the oil.

Should such a valve be adjusted by the spaces and orifice size to give the required feed for a given oil, and then supply an oil of lesser viscosity, or may be the same oil supplied hotter, or really a less viscous oil, then it will discharge much more rapidly, and instead of a horizontal combustion line there will be a rapid rise of pressure somewhat like a slow explosion. This indicates what is necessary if we desire to make a spray nozzle suitable for producing an explosion. To produce the explosive mixture and secure combustion of oil with the spray nozzle, the first step necessary is to reduce the flow resistance in the body of the nozzle by removing a considerable amount of the labyrinth surface or by reducing the viscosity of the oil by heating it. As a result the oil will be discharged much more rapidly and if enough resistance be removed from such a spray nozzle, it would give a substantially instantaneous injection of oil as a liquid spray. If that occurred we would have a more or less finely divided spray scattered through the mass of compressed air, and if this air is not up to ignition temperature, then we would have produced what might be called a liquid explosive mixture, ready for any kind of ignition that is handy. I say it is a liquid explosive mixture because no attempt has been made to vaporize the oil. All that we have done is to make really fine fog of liquid drops suspended in the air, scattered through the combustion chamber. To get such an explosive mixture or charge ready for ignition, it is necessary that no part of the interior walls or the air itself touched by the oil be up to ignition temperature, because if the air should be up to ignition temperature, as would be the case with the Diesel, then the oil would ignite as it came in, before the oil spray charge was scattered through the air. To get the explosion it is necessary to get all the fuel into the cylinder and scattered through the air before it is ignited, just as with delayed electric ignition. On the more desirable Otto cycle with its explosion, it is necessary to prevent the air reaching ignition temperature during compression; it must be incapable of igniting the oil, and the ignition, by whatever means is relied upon, must itself be delayed long enough to let the whole charge of oil get in the cylinder, because unless it is in there there is nothing that can explode.

Now, as to ignition. The common thing has been a hot plate; sometimes a bulk of spherical form with a neck to it; sometimes a hemispherical bulb without any neck, just forming a cylinder head; and sometimes all sorts of weird curves and twists and shapes—every one of them the subject of a patent. Now of that collection—that aggregation, what is good and what is bad? I will tell you a simple way of sizing it up. The hot metal—that is the igniter—must be so related in position to the injection point that no part of the oil reaches the hot plate before all of it is in the cylinder, and the shape such that no part of the oil reaches the hot plate before any other part.

Now let me give some illustrations and you will see the force of this principle. Consider a cylinder with a spray valve at one edge of a nice hemispherical plate, the oil being sprayed at an angle toward the plate, red hot. There have been lots of them made like that. The hot plates come up quite close to the injector, which discharged a more or less conical spray. Some of the oil will strike the hot plate before the oil is all in the cylinder and considerable of the air. Let us see what effect that will have. The first oil that hits that plate is going to fire the charge of so much as has entered? Much of the air is utterly inactive and cannot do anything as it has received no oil. At the same time an explosion of part of the charge has taken place and the rest is still coming in. What does it meet on the way in? A red hot—yes, a white hot—mass of inert gas. What will happen? Nothing but crack, liberating free carbon and carbon monoxide. The unused and unmixed air leaves free oxygen in the exhaust and with it the unburned fuel appears as carbon monoxide and lots of free carbon with plenty of solid carbon cake, inside. A very low mean effective pressure and low efficiency will result and, as well, the engine will be very dirty.

I say that the ideal condition is that in which no part of the oil strikes the igniter sooner than any other part and none of the oil strikes the hot plate until all the oil is in. Now, what kind of arrangement would give that? Suppose we had a spray valve making a cone-like spray, discharging axially into a hemispherical head, the center of which is the spray orifice. Then at the time the oil at full load had reached this hot ignition plate, the last oil would have come in if the dimensions were right. That sort of thing would be in conformity with the principle I laid down. Now I will tell you that that kind of arrangement will give anywhere from 50% to 100% more mean effective pressure than the non-symmerical arrangement previously described, and with it any compression you please may be carried. It does not matter how hot that latter plate gets, whereas the former has to be run cool on the side where the oil first strikes and yet hot enough elsewhere not to misfire. At full load it tends to get too hot and pre-ignite and knock its head off; with a light load it fails to get hot and fails to fire at all. And so the engines in that class are always provided with some kind of scheme to prevent getting too hot at heavy load and too cold at low load. The popular water injection scheme usually does nothing but wash the lubricating oil off the cylinder wall. For a long time, practically throughout the whole history of this art, this condition of necessary relation between the spray valve and the hot plate igniter has not been realized, and yet hot plate igniters have been in almost universal use. Now, hot plate igniters themselves are a bar to progress because if we use a hot plate igniter it has to be an outer wall. It has to be an outer wall so that you can start it with a touch and still not burn up. An inner wall cannot be started. A hot plate submerged in a cylinder cannot be started because you cannot get a torch at it from the outside. If a hot tube igniter be provided for starting and an internal plate relied upon for running, as is sometimes done, then you have no control over the hot plate and it will burn out. So a hot plate igniter has to be an

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outer wall to be practical, and when you have made it an outer wall to be practical then it is not really practical because it limits the size. That red hot plate lacks tensile strength. To be sure, a selected grade of cast iron can be found that won't lose too much tensile strength, but nevertheless it is very weak in proportion to what it might be. As cylinder sizes go up, and I have already indicated that one of the great fields of need for the heavy oil engine is ship work, which calls for cylinders to go up just as high as we can make them go, then the external hot plate is barred. It is no good because it is too weak structurally. Here is the place, then, where the functional problem leads to a structural debarment and where progress into the larger sizes requires an abandonment of the red hot plate as an igniter—or at least a very material modification. Now, if we can get along without it at all, then we need not fool with modifications, and as a result of that, though many people have tried various other schemes, and there is now being attained some success with electric igniters and with moderately warmed internal hot plates, which are more properly called "warm" plates. Suppose, with reference to the latter, that we have a 300 degree internal temperature and one would stop just short of ignition. Suppose we had a 300 degree initial temperature; then for practical reasons about 270 lbs. compression (see table) would carry the entire air above ignition temperature 200 degrees, and that would not be practical with late injection. If, however, we had the initial temperature of the air lower, or selected a sufficiently lower compression, we could come within 100 or 200 degrees of ignition temperature and still have a very substantial compression. As a matter of fact, it is perfectly feasible to use compressions up to 175, approaching 200 lbs.—possibly more—without reaching ignition temperature, provided the initial air is not too warm. Suppose we were injecting straight toward the piston and we had a spot of metal on there that did not get red hot but did raise the temperature of the air right next to it 200 or 300 degrees higher than elsewhere. That is all that is necessary for ignition, and that is one way that the thing might be done. A cold external wall for strength, a warm internal spot at the maximum distance from the igniter, not red hot but sufficiently warm to supply a couple of hundred degrees difference between the temperature attained by compression (which is not high enough to produce ignition), and the amount necessary to actually produce ignition at that one spot alone.

We do not know much as yet about that scheme, except that it is possible to run that way. Whether it can be developed into a practical controllable thing remains to be seen. I am inclined to think it can. If it can, then one serious bar to the increase in size and more extended use of the Otto cycle engine has been removed and a new field of most interesting and valuable possibilities opened up.

Without that, however, there is still another way of proceeding that is receiving some attention. For a long time back it has been known that with a sufficiently fine and proper kind of spray of oil into the air an ordinary spark plug would serve as an igniter. With the wrong kind of spray and plug the oil would collect at the spark plug and short circuit it, but a spark plug can be made to ignite the right kind of spray just as positively as it ignites a gaseous mixture. An apparatus involving the lighting of sprays by spark plugs I think is going to receive considerable schemes that are getting there.

Now, as to engine schemes: Suppose we had a thoroughly cold interior engine—an engine the walls of which were all cold, just as cold as we can get them, and to my mind you cannot get them cold enough for a good practical oil engine—the colder the better. Into the cold cylinder we admit a charge of air and compress it, but not sufficient compression to produce ignition, and when we get a sufficient compression to produce a highly economical engine as to oil and sufficient to produce a mean effective pressure of approaching 100 lbs. per sq. in., then ignite with this spark plug. That thing can be done, and it is a most interesting possibility. It is particularly interesting because in conjunction with it, it is possible to use a modified oil spray.

I have told you what most of you know anyway—that with the standard Diesel engine the oil spray valve is supplied with compressed air under a thousand pounds and more. Now, in the actual running of those engines the air compressor to supply that air and the air storage are just about as big a nuisance as the engine—sometimes, in fact, I think often more. If we could get rid of that, it would be a splendid thing to do. "A solid" spray is, therefore, a highly desirable thing.

So far we have succeeded in making a number of engine solid spray valves that work quite well, and they work so well that I feel confident that the end of the compressed air spray is drawing near, and that thereby we are going to eliminate another big source of trouble. I am not sure that the solid injection spray that I have in mind will work on the Diesel engine, because the Diesel engine remains a graduated feed, and I am not at all sure that the principle of action of the solid spray can be adapted to the graduated feed. I know that it works splendidly with the instantaneous feed for the Otto cycle or explosion engine. There is only one principle that needs be kept in mind to explain the many ways of working out the solid spray, and that principle is pretty old. It is the principle of the Navy fuel oil burning spray for boilers. The Navy and other ships cannot afford to use compressed air or steam for spraying oil, as is so common on land, because they have not the fresh water with which to produce this steam. They are, therefore, compelled to use mechanical spray, and this type of spray has been very highly developed. It involves nothing more than a minute orifice from which the oil is discharged with a combined motion axially through the hole and rotary as it comes out; the rotary motion being developed before the oil reaches the hole in a rifling tube or tangential feed passage to a little whirl chamber just back of the spray orifice. By giving the oil a whirl behind the spray orifice with a proper exit from the orifice, then it issues with a motion in two directions—axial and rotary—producing a sort of solid conical spray that is fine and works well in an engine. By making the passages small enough in such a spray valve so that they are practically capillary, then a direct acting pump plunger slamming against the solid column of oil will make such a spray without any dribble at the ends of the spray period. We must remember that no dribble at the end or beginning of a spray is permissible, because every drop that dribbles carbon izes. To avoid the dribble the only thing necessar is to get the passages substantially capillary in siz and that is not difficult. At first glance it would see as if that boiler spray valve could not be made t work with rapid intermittance, but it can and is s working today.

Now, a word or two on the structural side. I hav in planning this little talk, overreached my capacit I thought I would get over more ground and hav more time to talk about the structural features. W may assume that this functional question has in considerable undeveloped possibilities and that thes are not mysteries but that they are lines of purel rational progress, the key to which we have in ever instance and nothing is unknown except how far yo can go. We know the route every time: We do no know how far we can go. Assuming that you ca see with me in your mind's eye non-Diesel late in jection high efficiency oil engines working as we as the Diesel — and I hope better — then arises th question: How should the structure be built? Ar there any lines of standardization that can be we and properly applied there. Or is every designe to regard himself as the one selected by the Almight to produce something that no one else ever made For some strange reason that seems to be in th minds of almost all oil engine designers. Whil for years we have been building crank shafts, frame and engine structures for steam engines and simila structures for pumps and compressors, just as soon a an oil engine designer gets his hand over a drawin board he wants to throw all that experience away an get up some other thingamojig and make more troubl than do the parts, parts that are peculiar to the o engine.

Now, the point of view to take with regard to thi structure, I think, is this. There is no essentia difference in kind, except the cooling problem, betwee an oil engine cylinder and a steam engine cylinder The difference is one of degree in the structura problem. There is no essential difference, certainl none in kind between the problem of the frame an the bed plate and the rest of the running gear of th oil as compared to the steam engine. That being th case, I fail to accept all these queer arrangements tha have crept into the oil engine field and that hav become more or less standard there, quite contradict ing all previous experience and established custon with the more firmly established steam engine. T my mind there is no difference whatever in the desig of a column to support a bridge, pier or a building or to support a statue, and I do not care what you put on it; all that counts is the load to be placed on it. And yet the oil man has persisted in carrying out his structure from cylinder down to bed plate, on radically different lines than has long been standard with steam, and Heaven knows why. The result is hopelessly bad. I say there is a lot of room there—not for invention, for this is where it becomes time to kill the inventor or put him away. Rather let us bring out some of our good old designers who understand the designing and building of structures to carry loads, and I wouldn't tell them anything about the oil engine peculiarities at all. Some other man is taking care of that. Then we will get somewhere.

(To be continued.)

CONCRETE DIESEL-DRIVEN MOTORSHIP BUILDING AT HOUSTON, TEX.

One of America's largest full-powered concrete motorships now is under construction at Houston, Texas, and is a vessel of 2,000 tons (long) cargo capacity, and will be propelled by a 300 b.h.p. McIntosh & Seymour Diesel type crude-oil engine. At the back of this enterprise are the Houston Bank & Trust Co., Mr. B. M. Garrett, president. Discussing this new development, Mr. Garrett says:

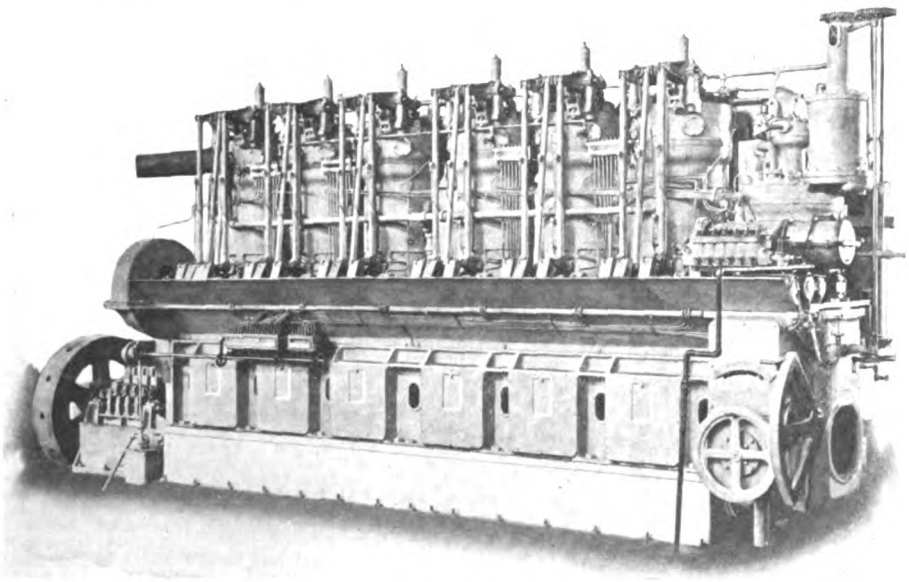
"The Houston Bank & Trust Company has added to its organization a Marine Department, and has leased the Pan-American Trading Company's shipyard at Houston Terminals and is adding two more ways to it. When these ways are completed the yard will be equipped with four shipbuilding ways, two for end launching and two for side launching.

"We have purchased the light and power plant formerly at Wilson, Kansas, and are moving this plant to Houston Terminals. The yard will be electrically equipped throughout with large boom derrick electrically driven for unloading ships and barges from the company's wharf onto electrically driven tram cars that distribute cargo throughout the company's yards.

"The first ship to be built, material for which has already been purchased, will have a cargo capacity of 2,000 long tons and will carry 50 cabin passengers. This ship will be built of reinforced concrete and will conform to the very latest approved ship lines. This ship is being built for our own account and will be put in service as soon as completed, which will be about August 25th. This boat will be driven by a 300 H.P. Diesel-type engine which is being built by the McIntosh Seymour Corporation of Auburn, N. Y. ["Motorship" considers this power should be trebled.—*Editor.*]

"It is our purpose to specialize on concrete construction and to equip our yards for the rapid construction of boats of this material. We have some 50 men working on the yards at this time, and will put on more men as fast as houses can be built for them to live in, a large number of which are under construction.

"We expect to have all four of our ways in service within the next thirty days, and when not used to construct ships under contract, we will use them for constructing ships on our own account."



McIntosh & Seymour marine Diesel engine as to be installed in the 2,000 ton concrete tanker at Houston, Texas.

PROPOSED AMERICAN CONCRETE MOTORSHIPS

The latest methods of building vessels should have the most modern methods of driving them through the sea. This is the principle upon which the Motor-Ship Corporation of California has been incorporated; and the corporation is going to start a little drive of its own to raise $750,000.00 to bring its dream into concrete reality. A. E. Roberts and R. Thompson, San Francisco engineers and marine architects, are the men who have "dreamed" the corporation into legal existence with the assistance of Attorney Jesse Onley. Humphrey Devereux and F. K. Blue, who are also engineers, are the men who assisted the projectors in making their plans to bring into being the concrete motorship. A site has been selected at Martinez, Cal., along the waterfront of that city, and all the plans are completed for the first ship, which will be about 3,500 tons burden.

It is understood that the projectors have not as yet decided on what type of engine they will use; but it seems reasonable to assume that it will be of the Diesel surface-ignition type, as the heavy oil engine alone has so far proved a success in large vessels. There is no doubt that the anticipated success of the concrete ship "Faith" recently launched at Redwood City has had a great deal to do with the determination of the projectors to go into this new enterprise; but the report from Washington that the head of the U. S. Shipping Board had approved of the motorship for the Pacific trade, together with the difficulties which the Government-built ships are said to be having in getting their marine steam-engines without delay, was the final factor which turned them to the motorship. The San Francisco Shipbuilding Co., which fabricated the "Faith" at Redwood City, is preparing to build three more vessels of a like type and heavier tonnage. It is said that they are considering the proposition to power at least one of these vessels with a crude oil engine, but on this point the management is silent.

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The Internal Combustion Engine

Utilization of Oil Derived from Coal

By P. N. EVERETT, A. M. I. C. E.

[In the April issue of MOTORSHIP some extracts were given from a general survey of the internal-combustion-engine read before the Association of Engineering and Shipbuilding Draughtsmen (Gt. Britain) by Mr. P. N. Everett, and which included a reference to the 72 hours non-stop run of the new Armstrong-Whitworth marine Diesel-type engine. The contents of this paper is of such value and interest that we herewith give further extracts; but we have been obliged to delete much matter dealing with other branches of the internal-combustion-engine, as MOTORSHIP is purely a marine journal.—*Editor.*]

THE War has demonstrated the complete triumph of the internal-combustion-engine, which is the motive power of the most menacing weapons of offense and defense, namely, the aeroplane and the submarine, and in addition it drives *monitors;* auxiliaries; motor-boats for river and sea; tanks; zeppelins; seaplanes and hydroplanes; transport vehicles of all description, and also supplies the power for isolated wireless and searchlight stations. The pressure and necessity of war has driven many old firms into the manufacture of either Diesel engines for submarines, or aero engines for flying machines, and the high-class nature of the product cannot fail to have the most wholesome effect on the general tone of both the works and the men.

The question of fuel is one of paramount importance at the present time. Germany's aerial and submarine operations were restricted until they stole the Rumanian oilfields. Norway is so short of coal that they are burning wood in their locomotives. Australia's petrol supply has dwindled down to zero, and they are making great efforts to produce alcohol from home grown material. France and Italy are dependent almost entirely on this country (Gt. Britain) for coal, and our own petrol (gasolene) supply is causing the very gravest concern, and yet all this time we are recklessly squandering our great national asset in a most appalling way.

For years Commissions and Committes have been issuing warnings, all of which appear to fall on deaf ears. The three great by-products which can be obtained from coal, if it is scientifically handled, are tar, benzol, and sulphate-of-ammonia, and our barbarous methods of consuming our annual amount of 280 million tons of coal result in a loss of 2,000 million gallons of tar oil suitable for naval purposes, 300 million gallons of benzol for motor vehicles, and three million tons of sulphate-of-ammonia, the most valuable artificial fertilizer known. It is worth a digression here to state that scientists predict a shortage in the world's wheat supply due to the wheat-eating population increasing at a greater rate than the wheat, and it is therefore more and more necessary to use an artificial fertilizer; in fact the demand for ammonia-sulphate for agriculture has doubled in amount during the past 10 years.

Table of Thermal-Efficiencies on B.H.P.

1. Average triple expansion set, assuming 1.5 lbs. of average coal per I.H.P. hour and 90% mech. efficiency of engine.....	11.4%
2. High class overtype engine and boiler fitted with superheater. Consumption 1.21 lbs. coal per B.H.P. hour.....	15%
3. Large gas plants where by-products are abstracted and sold. About 1.20 lbs. per B.H.P. hour of Bituminous slack.....	18.5%
4. Suction-gas producer, too small for recovery of by-products. About 0.60 lbs. Anthracite per B.H.P. hour.....	28.3%
5. Low-compression 2-cycle oil-engine 0.50 lbs. B.H.P. hour.....	26.4%
6. 4-cycle Diesel Oil-Engine 0.40 B.H.P. hour.	33.5%

As a mechanical power producer for marine propulsion, however, when one considers a boat of about 8,000 tons with, say 3,500 H.P. in her engines, requiring 12 cylinders with 48 valves, besides H.P. compressor valves and with bottles, etc., charged up to 800 lbs. per sq. inch, one is inclined to think that it cannot be the final development of the I. C. engine, nor do the qualified results obtained in practice from the valveless two-cycle engine alter this opinion. In fact, the present divergence in design and the success of opposing ideas proves that the Diesel engine is still in the transition stage.

At the same time it should not be forgotten that several single-cylinder units of 1,500 B.H.P. have had experimental runs, with a fair amount of success in the aggregate. To fully realize what this means, take the case of a four-screw boat with 10 cylinders on each shaft; this would give 60,000 B.H.P. which will be recognized as about the shaft-horse-power of the "Mauretania." Such engines could be accommodated in about one-fifth the space taken up by turbines and boilers, and would do away with about 300 men, making a reduction in the wage bill of about £36,000 ($180,000.00) per year. (British scale of wages.—Ed.) The increased earning ability in view of increased cargo capacity needs no comment.

These figures are only approximate, but an engine which holds out such possibilities should at least engage the very serious attention of all heat-engine designers, even if the present production does not come up to expectations. The reduction in the fuel-bill alone would amount to nearly $3,000.00 per day with coal at $5.00 per ton. But it should be here remarked that the piston-load of such an engine would be about 300 tons on each piston, and the crank-shaft about 24 inches diameter; so it will be agreed that it is not a task to be entered upon lightheartedly by even the most experienced of designers.

Solid-Injection

The air-compressor on a Diesel engine has always been looked upon with great suspicion, and there is no doubt that the design and manufacture of a compressor running at the seep and pressure suitable for a high-speed Diesel engine, i. e., about 300 r.p.m. and 1,200 lbs. per square inch, is a job for the specialist. In the early days of the Diesel engine the difficulties of the job were not sufficiently appreciated, with the result that in service conditions considerable trouble was experienced with the compressor. Further, they were often designed as two-stage compressors when three stages were necessary.

These troubles led to an effort being made to dispense with the compressor and force the fuel through the fuel-valve into the cylinder by means of the pump. This system is known as "Solid-Injection," and is of British origin and development. Continental makers have tried and discarded it. Diesel's preliminary experiments were with solid-injection, but he soon decided that air-injection was necessary.

There is no doubt that a considerable advantage is obtained by spraying the fuel in by air-pressure, which must of course be greater than the compression-pressure. The oil in the sprayer body will be in a state of froth, and when it reaches the highly-heated air in the cylinder every particle will be surrounded with air, which will be of decided assistance to speedy and complete combustion. However, with certain people the "Solid-Injection" engine has found favor. (Vikers engine in England and the Price engine in America—Editor). The scheme is shown diagramatically in Fig. 1. It is necessary to work (Vikers system) to high pressures—2,000 to 6,000 lbs. per square inch, and the oil is forced through fine holes 15 to 20-thousandths diameter. It will be readily understood that the maintaining of 16 to 24 of such pumps in "going order" needs considerable skilled attention, as a small leakage at the pump or in the system, or a little dirt in the sprayer or pump valves, will easily put a cylinder out of action.

Rating and Fixing of Sizes

Horsepower is a function of the product of the mean-effective-pressure in the cylinder and piston-speed. Piston-speed is limited by rubbing speed, and under some circumstances gas velocities. It is a function of the product of the stroke by r.p.m., revolutions being limited by the nature of the drive and purpose of engine, and stroke limited in relation to cylinder bore. In general the cylinder diameter should be kept as small as possible to reduce the piston load and the additional difficulties of the heat problem; but although high piston-speeds mean low weight per horsepower, there is the disadvantage of extra wear and tear, greater liability to breakdown, and sometimes trouble is experienced in getting sufficient port area to give reasonable gas velocities. These points are more or less common to all reciprocating engines, and so there is no need to elaborate them here.

Stroke-bore-ratio is often given more consideration than is here considered necessary. Theoretically it certainly has an effect on the thermal efficiency in varying the ratio of volume to surface of combustion space; but in practice other points usually decide the matter. For instance, in an engine with a built-up crank-shaft the stroke-bore-ratio is fixed at about 1.8 to permit of this design, and in the case of an engine for a submarine where the design must be as squat as possible the ratio is made from 1 to 1.1. This is irrespective of whether the engine is four-stroke or two-stroke cycle, and has nothing to do with thermal efficiency.

As regards mean-effective-pressure, this is usually taken to be the mean of the excess of pressure per-square-inch driving the piston during the firing stroke, over that required to compress the gas during compression stroke, and is measured by the mean height of the positive loop on the indicator card. A certain amount of power, however, is used in charging the cylinder, and on working the engine, and in Diesel engines in driving the air-compressors and all the necessary pumps.

The commercial measure of an engine is not the scientific efficiency in the cylinder, but the power given off at the crankshaft, and this power is termed the brake-horsepower. It is now customary to use in the usual horsepower formula, a figure which allows for all these deductions and thus gives the brake-horsepower. This figure is spoken of as the brake-mean-pressure.

$$\text{B.H.P. (4-cycle)} = \frac{\text{B.m.p. x area of cylinder x piston speed.}}{4 \times 33{,}000}$$

In the case of 2-cycle engines, substitute "2" for "4."

A few values of the above for leading types of engines are as follows:

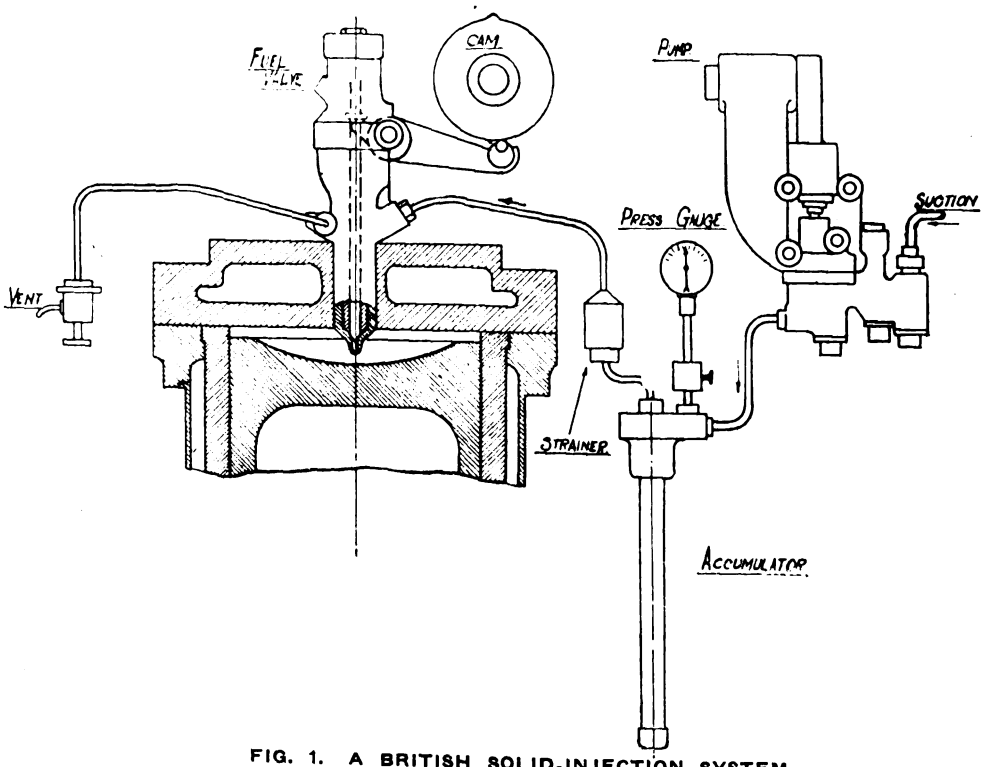

FIG. 1. A BRITISH SOLID-INJECTION SYSTEM REFERRED TO BY MR. EVERETT

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The auxiliary steel ship "Itamaraca," ex "Parkdale," owned by the Companhia Nacional de Navegacao Costeira of Rio de Janeiro. She is driven by two Sulzer-Diesel engines of the two-cycle type. Length 249', breadth 36' 5", depth 21', 7", tonnage 1,480 gross tons. She was built in 1891 at Londonderry and recently converted to motor power.

Type	Description	B. H. M. lbs. sq. in.	Piston Speed ft. per min.	Stroke BORE
Low-Compression Oil Engine	2 stroke cycle	28-32	500- 700	1.0 -1.1
Diesel Oil engine	Marine 4 stroke cycle	73-78	600- 750	1.35-1.6
	High Speed 4 stroke cycle	70-75	700-1000	1.0 -1.35
Diesel Oil engine	Marine 2 stroke cycle	66-70	600- 750	1.6 -1.9
	High Speed 2 stroke cycle	60-66	700-1200	1.0 -1.25

When the first engine of a new type is being designed and built, it is difficult to fix the best conditions of m.c.p., r.p.m. and piston speed until the engine has run on the test bed. For instance, the inability of the cooling arrangement to efficiently carry away the heat has sometimes caused the r.p.m. and m.e.p. of a 2-cycle Diesel engine to be reduced—causing a serious reduction in the horsepower developed. It is customary to rate an I.C. engine at the maximum B.H.P. it will maintain continuously, which is about 85% of the maximum it would do for short spurts. This is quite reasonable and correct; but, in the event of it being necessary to reduce either mean-pressure or piston speed, it becomes quite impossible to make up the horsepower.

Temperature

It is most likely that the maximum temperature actually attained in the cylinder is probably nearly 3,000° F. The melting point of cast-iron is about 2,000° F. Fortunately these enormous temperatures are prevented from reaching the cylinder walls by some action of the adjoining layer of gas. This was proved experimentally by sticking patches of tinfoil on the inner surface of the compression space of a small gas engine. The patches were not melted by the heaviest charges of gas, proving that the temperature of the adjoining surfaces never exceeded 450° F. To keep these surfaces cool they are surrounded with a water jacket which carries away the heat, thus preventing the temperature of the outside rising much above 150° F. The reception of heat by the inner surface varies at each instant throughout the cycle, and is greatest by the parts always in contact with the gases, that is the combustion chamber. Moreover, owing to differences in thickness and the joining of ribs, webs, etc., certain parts of the casting are further away from the water than others, with the result that a great unevenness in heat distribution occurs, producing local high temperatures. As the size of the engine increases these inequalities are increased, resulting in unequal expansion and contraction which has in the past led to many failures.

When designing such parts due consideration must be taken of the fact that portions separated by only a few inches may differ in temperature by 400° F. to 500° F. The whole problem is very much aggravated by a deposit of carbon, tar or other bad conducting material, even if the deposit is on a water-cooled portion. The piston, if not water cooled, is in a much worse condition than the cylinder, as the heat has to travel from the centre to the edge, down the skirt, across the oil film, and through the cylinder to the jacket. The centre of a piston might, therefore, reach a temperature of 750° F. while the edge would be about 430° F. Such a difference of temperature would produce, in a piston of normal design, a stress of about 5½ tons per square inch. These temperatures are borne out by practice, as it is no uncommon thing to see the centre of a piston at a dull red heat. All this must be considered in conjunction with the fact that the piston has to be gas-tight to 500 lbs. per square inch.

Heat Transfer.

The above temperatures are entirely dependent on heat transfer in order that the jacket water can carry heat away, the heat must flow through the cylinder walls; and further, to be a flow there must be a temperature difference between the inner and outer surfaces. The further a part is from the water, the greater must be the temperature difference, and in order to prevent overheating in the cylinder the jacket water must carry away the heat as fast as it is added.

In the sets under consideration the steam set has six furnaces, and the Diesel six cylinders. One of the drawings given (not published because of pressure on space—Editor) shows to scale a boiler with three furnaces and a set of three Diesel cylinders. About one-third of the fuel stoked on to the boiler grate is burned in the small cylinders of the I.C. engine; but combustion takes place in about one-tenth of the time. The heating surface per furnace for the boiler is about 1,020 sq. ft. The surface per cylinder enclosing the combustion space is about 7.8 sq. ft., and the total cylinder surface for carrying away the heat about 30 sq. ft., i. e., less than one-thirty-third of the surface available for heat transfer in the boiler. These figures give some idea of the tremendous intensity of combustion in the cylinder of an I.C. engine.

From the heat carried away in the jacket water and from the amount of steam generated in the boiler, it is possible to calculate the approximate heat transfer in each case and in two diagrams below the cylinders and boiler illustrate graphically this point. Both diagrams refer to the same total time, but reality the transfer in the I.C. engine takes place in less than half the time, namely, during the combustion and expansion period of the cycle. This only touches the merest fringe, of what is the crux of the large I.C. engine problem; but it is sufficient to show the absolute necessity of specially selected materials, special arrangements for lubrication, and exceeding great care in design, manufacture and operation.

In a steam set, fuel is supplied by the "shovel full" at the pleasure of a fireman. In the Diesel set it is fed mechanically in definitely measured quantities—about 0.025 of a pound in the case under consideration—and any great increase in this amount might, with an extra supply of air, blow the cylinder cover off. This question of independence of the human element in fuel feeding will appeal to the seagoing engineer, judging by the conditions most firemen are said to be in when leaving port.

The scope of the marine line is too large for the limits of this paper except to mention a few details. At the present time the most successful engine is the Diesel, and although we have not as yet a British supply of suitable fuel, a boat trading with a country with an oil supply, could fuel there, taking in sufficient for the round journey, and still devote less space to bunkers than the present steam ship. This war, however, has surely taught us not to develop our necessities so as to be dependent on any other nation, and it therefore appears obvious that either an oil engine running on tar-oil, or a gas engine and producer must ultimately come even for marine propulsion. In the meantime, the present Diesel engine is being severely tested, and to give it a fair chance the naval architect should see that the seating is amply strong. Many cases of crank-shaft fractures and other failures have been directly traced to excessive vibration due to weak seats.

P. N. EVERETT.

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NEW ENGLAND MOTOR FISHING VESSELS

In the East Coast fishing industry crude-oil engines are rapidly jumping into favor, and there is a little golden harvest awaiting the builder of moderate-powered heavy-oil motors of the surface ignition, or Diesel type, who makes a thorough campaign of the New England coast, provided he is willing to spend a reasonable amount of time and money in properly developing this field, and providing he keeps the cost of his engines somewhere round the $100 per b. h. p. mark, and does not demand about $150 to $200.

A recent New England visitor to New York was the "Corinthian," a new two-masted auxiliary schooner owned by the Gordon Pew Vessels Company, of Gloucester, Mass., which well-known fishing-boat owners have several heavy-oil-engined craft engaged in this work, as well as steam and gasoline-engined boats. The "Corinthian" started from Gloucester on her maiden trip on May 4th, proceeding to Newport, Rhode Island, where she stayed for 24 hours, thence running down to about 130 miles south of New York in latitude 38 in search of mackerel, and from there to New York, where she arrived on May 8th, staying there for a few hours, partly to change a connecting-rod bearing-brass.

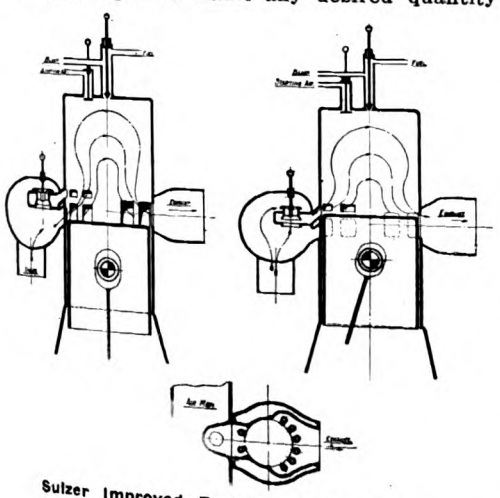
To illustrate the confidence placed in oil-engines by her owners, we will mention that only one engineer is carried, and he has not any assistants or oilers. Capt. F. Vautier, an old sea veteran—informed us that he has never known anything so reliable and fine as these oil-engines. Last year, he commanded a fishing vessel powered with two h. p. Fairbanks—Morse crude-oil engines, and ran her from April to November, without the slightest machinery trouble or mishap.

The "Corinthian" is of 161.35 gross tons, and of 89 net tons; her under deck capacity being 149.15 tons register; but, of course, she can carry more cargo than the latter figures. Her length is 112′ 6″ by 23′ 9″ breadth, and 10′ 8″ molded depth. Her power plant is a four-cylinder 14″ by 18″ Fairbanks-Morse crude-oil motor of 250 b. h. p. Her papers give the engine-room space as 17.72x1.75=37.01. The engine is direct-reversible, and has the new type of water-cooled hot-bulb (or vaporizer) as well as a water-cooler ring on the cylinder cover. Forced lubrication is supplied by Madison-Kipp lubricators.

The engine uses 12 gallons of oil-fuel per hour, which averages in cost at various ports 12 cents per gallon. This means that she has a fuel bill of but $1.44 per hour at full speed. Owners of steam craft of this size can easily compare these bills with that of the "Corinthian."

SULZER PORT-SCAVENGING SYSTEM

With reference to the illustrations of the Sulzer two-cycle class 1,500 b.h.p. submarine type of marine Diesel engine, illustrated in "Motorship" for June last, the special system of port-scavenging of the exhaust gases no doubt will be of particular moment. The accompanying sketch diagrammatically shows the Sulzer improved design of port scavenging. There are two horizontal rows of air-ports, arranged one immediately above the other. The lower row is in direct communication with the scavenge-air receiver, and is controlled by the main piston alone. The admission of air to the upper row, is controlled by special valves, which are mechanically operated from the cam-shaft. This upper row of ports is arranged higher in the cylinder wall than the exhaust-ports, so that when the exhaust-ports have been closed by the piston, the upper air-ports still remain open to admit any desired quantity of air, without fear of it blowing straight through to the exhaust. The double-beat valve further prevents the exhaust-gases forcing a way into the scavenge-air receiver, while they are at a high pressure. In the case of the Sulzer, or cam operated, valve design, the scavenge period is not made symmetrical, with the exhaust about the line of dead centres; but would open after, and close after, the exhaust period.



Sulzer Improved Port-Scavenging System

URGENT NEED FOR OIL ENGINES

Last month Chas. Schwab stated that the situation regarding marine steam engines and boilers was critical and that 80 to 90 hulls were in the water awaiting propelling power. For the same reason the Shipping Board will not permit at present any private construction of concrete steamships.

This makes it very advisable to immediately utilize to the full every available stationary and marine oil-engine works in the United States, and fill them up with orders for marine heavy-oil engines for America's merchant ships. The capacity of several of these plants is by no means full, and there are others to which extensions easily can be made, which will considerably augment their present output. Some of these works are anxious to obtain Government orders, others are doing a fair business with private ship-owners.

LICENSES FOR N. Y. HARBOR MOTORCRAFT

All motorcraft of over 20-ft. length operating in the harbor of port of New York must have a special license obtainable from the Deputy Collector of the Marine Division at the Customs House, Bowling Green, New York, N. Y. Permits to carry Kodaks or other cameras aboard vessels or boats in New York harbor can be obtained, upon showing good reason therefor, from the Surveyor of Customs at the same address.

CAPITAL INCREASE OF MOTOR TANKSHIP OWNERS

The ordinary share capital of the Shell Transport & Trading Co. is to be increased from $25,000,000.00 to $80,000,000.00. The Shell Co. market the oil transported by the Asiatic Petroleum Co., an associated concern that operates many motor-driven tankers. Both are subsidiaries of the Royal Dutch Petroleum Co.

CHANGE FROM GERMAN TO ITALIAN ENGINES

Apparently the Kawasaki Dockyard Co., Ltd., of Kobe, Japan, have abandoned the M. A. N.-Nurnberg design of submarine Diesel engine, the constructional rights for which they acquired over four years ago; because they now are building the 1,300 b. h. p. Ansaldo (ex Fiat) San Giorgio submarine Diesel engine for the 1,070 tons (submerged) displacement submersibles for the Japanese Navy.

THE "BEATRICE CASTLE" SOLD TO FRANCE

The five-masted auxiliary schooner "Beatrice Castle" built at Victoria, in 1917 for H. W. Brown, Ltd., has been sold to French shipowners. This vessel has a two-cylinder 16½″x20″ Bolinder oil motor for auxiliary propelling power, and she is 245′ 3″ long x 43′ 8″ breadth and 21′ molded depth. She has a gross tonnage of 1566 tons.

MOTORSHIP "ALABAMA"

The large McIntosh & Seymour Diesel-engined wooden motorship "Alabama" biulding at Seattle, Washington, has been sold to French interests by her owners, the Alaska-Pacific Navigation Company. Her length is 270′x46′ beam and 26′ depth.

MOTORSHIPS BECOMING MORE COMMON ON PACIFIC COAST

The sight of motorships on the bay of San Francisco is becoming more common every month. Scarcely a day passes by now that some motorship, either big or little, is not crossing the bar on the way to port or just starting on a long sea voyage. The Norwegian and Danish ships are the largest calling at this port, and nearly all the time one of these big freighters can be seen discharging or loading at the dock or anchored in the stream awaiting orders. The "George Washington," "Chile," "Australien," "Brazil," "Bayard" and "Selandia" all were in port recently, and these full-powered motorships would attract attention in any port. The rest of the callers in San Francisco bay this month were of the smaller, auxiliary type—staunch vessels, all of them, but not so imposing as the big steel, Diesel craft.

The recognition of the importance of the motorships by the U. S. Government and the promise of assistance in building this class of vessel for use on the Pacific has been hailed in San Francisco as one of the most important developments in the progress of the motorship that has come to the surface for some time. C. G. Cox, local representative of the McIntosh & Seymour Corporation, says that there is no doubt that the shipping men are becoming more and more interested in motor ships. He finds that interest almost universal, and while the ship owners are slow in adopting the motorship they are becoming better acquainted with its advantages and possibilities every day.

DRIFT BOLT DRIVER FOR SPECIAL WORK

While shipbuilders are bending every effort to speed up each step of ship construction, the builders of the tools that play so important a part have not been idle. Their task is the development of new and better machines, so that a few seconds may be cut from the time required for each operation. The Ingersoll-Rand Company's latest contribution is an air-hammer, especially designed for drifting up bolts. This tool enables one workman to do in a short time that which would otherwise be a relatively slow task needing two men. There is also the consideration that the new hammer makes the work far less fatiguing.

Ingersoll-Rand Drift Bolt Driver

The distinguishing feature of the tool in question is a telescoping leg or air feed. This portion of the device consists of two sections of seamless steel tubing, one of which slides within the other and is provided with an air tight cup leather. Air, when admitted, extends the tool until it is against the bolt to be driven, where it is firmly held by air pressure while the bolt is being driven. A single three-way throttle controls both functions of the tool. The hammer element is identical with that of that other member of the previous Ingersoll-Rand Drift Bolt Driver. The new tool is very powerful and will drive bolts of 1½ inch diameter up to 10 feet in length. It weighs 90 lbs., is 55 inches in length, when air feed is closed, and 77 inches in length when fully extended.

Another Ingersoll-Rand tool is the Littzer pneumatic calking machine, which weighs but 13½ lbs. and observed performances show that it can be easily handled and operated in any position. It automatically tacks either machine or hand spun oakum in side or bottom seams to any depth required for final horsing. On deck planking it will also do the horsing. Its working speed is about 1,500 tacks per minute, either coiling or running the oakum straight.

The "Littzer" calking machine is controlled by a trigger. It differs, however, from the usual hammer in that the piston has an extended rod fitted with a thin calking blade. This, being a reciprocating iron with positive pull back, has no tendency to bind. The calking iron travels in guides which prevent it from turning, the whole being fitted with springs so that the workmen can vary the penetration of the calking iron with the varying depth of the seam. A unique device automatically feeds the oakum with each movement of the calking blade. Guide wheels run in the seam being calked and keep the threading iron lined up. The tool operates with negligible vibration and its design is such that it follows without effort on the part of the workman; in fact, machine calking is so simple that ordinary workmen can do highly efficient work. A demonstration was recently conducted before the U. S. Shipping Board, Emergency Fleet Corporation, and the tool was approved by them.

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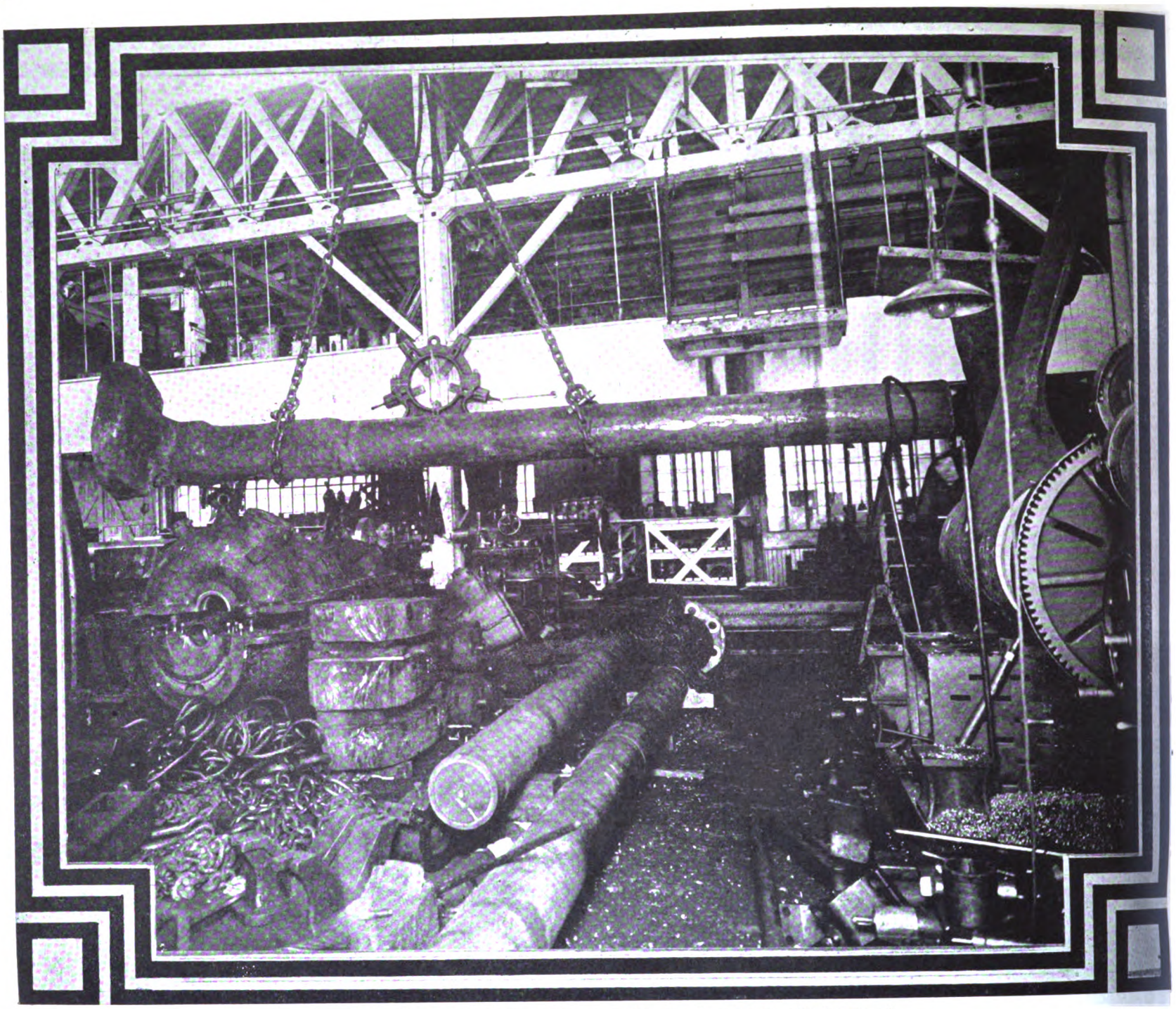

Largest Rudder Stock Ever Made on Pacific Coast. Weight, 20,000 Pounds.

Ship Forge Manufacture On the Pacific Coast

The Seattle Plant of the Pacific Construction and Engineering Company

AN IMPORTANT incident in the enormous expansion of the shipbuilding industry on the Pacific Coast was the incorporation of the Pacific Construction and Engineering Company of Seattle, Wash., which was organized and established through the foresight of Robt. C. Monteagle, who until his new venture was assistant to the President of the Seattle Construction and Drydock Company of the same city. In his former capacity Mr. Monteagle saw and realized what things were most needed to help speed up ship construction in the region named. Although it was prior to the entrance of the United States into the war that this company was formed, Mr. Monteagle was able to foresee that a very urgent need would arise for the manufacture of heavy ship forgings and shafting. He severed his connection with the older company and immediately gathered about him a complete organization of experienced men with the end in view to be able to cope with any exigency that should arise. The officers of the company formed of these men are as follows: Robt. C. Monteagle, president and general manager; A. N. Gillespie, vice-president; Henry Smith secretary and treasurer, and Jas. Bingham, general superintendent. An ample supply of capital was available for such an enterprise, so plans for a complete plant were drawn up, an admirably suitable location in the heart of the shipbuilding industry

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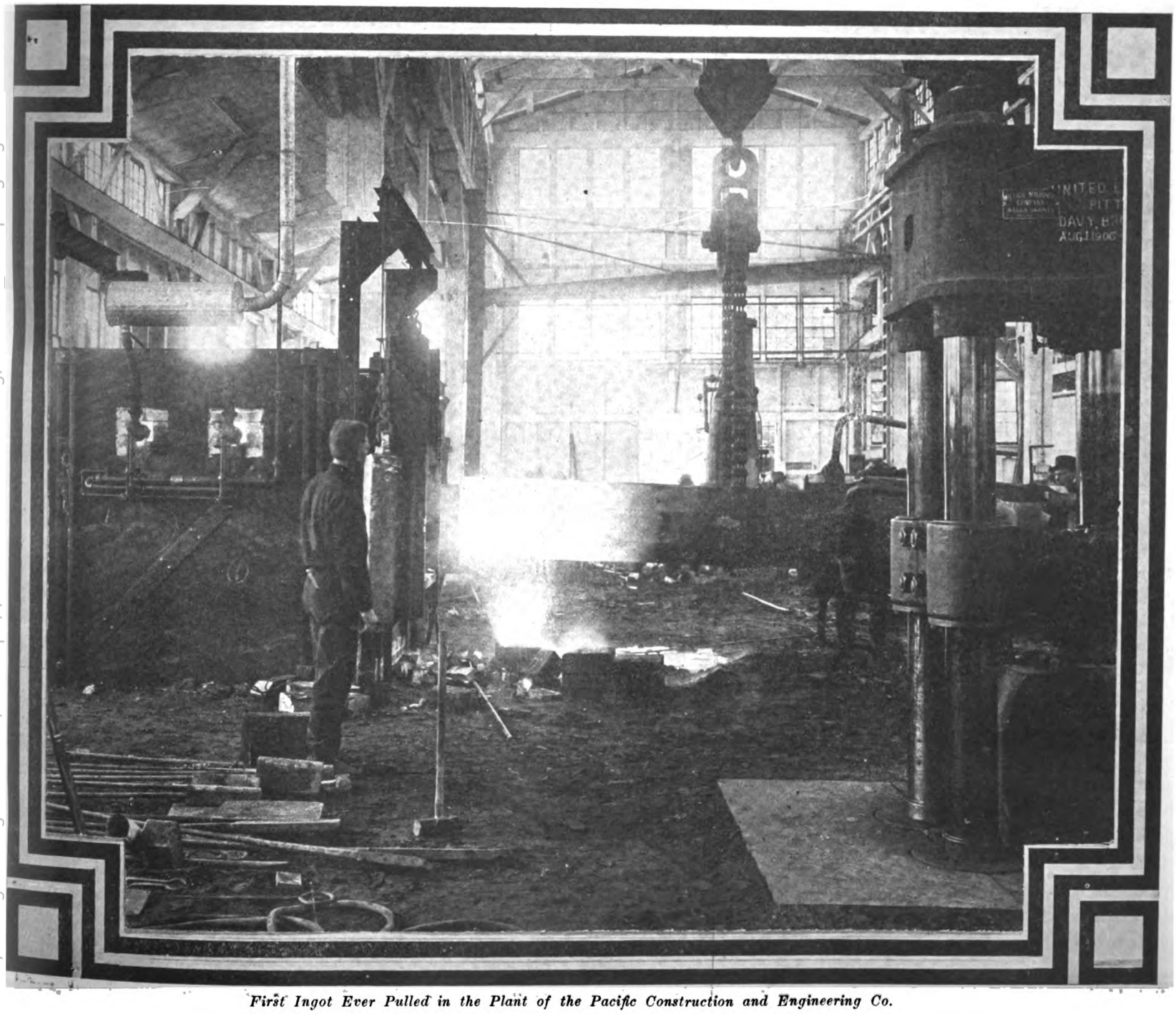
was obtained with both rail and deep water facilities, and contracts for the large tools required were let, so that by the time the plant was built everything was in readiness. Since their start the company has gained an enviable reputation in speed in turning out their products and in the quality of the goods. In this connection it may be stated that with their facilities they have been able to take care of one of the largest and most important needs presented by the present emergency and has formed of itself a vital necessity. A complete outfit of forgings, such as shafting, rudder posts, etc., for an 8800-ton freighter are completed each day; this can be duplicated, to our knowledge, in only two plants in the entire country.

The plant is located, as has been stated, in the very heart of the shipbuilding industry of Puget Sound. The main buildings at present are 400 feet long and 120 feet wide with a height of 100 feet—sufficiently high to operate the heavy electric Shaw cranes installed, of which there are three now in operation and one in the process of installation. They are all of 25 tons capacity, and cover every part of the plant. A new addition is to be made in the near future; 200 feet is to be added to the plant to accommodate the new tools which are to be installed. Some of the tools already in the plant on the following: Two quick-acting steam hydraulic presses (one of 1200 tons and the other of 600 tons), a 2500-pound hammer used for the smaller forgings, lathes for the making of test bars, shapers for the test bars, drill presses, air compressors used for chipping or centering the shaft, and the various appliances in the testing laboratories and a large testing machine made by Tinius Olsen of Philadelphia. A battery of twelve furnaces ranged along one side of the shop enables them to have an ample number of ingots in the fire at all times. These furnaces were designed by the company and have proved themselves very efficient. They are heated by oil and give a heat of 2500 degrees F. The



First Ingot Ever Pulled in the Plant of the Pacific Construction and Engineering Co.

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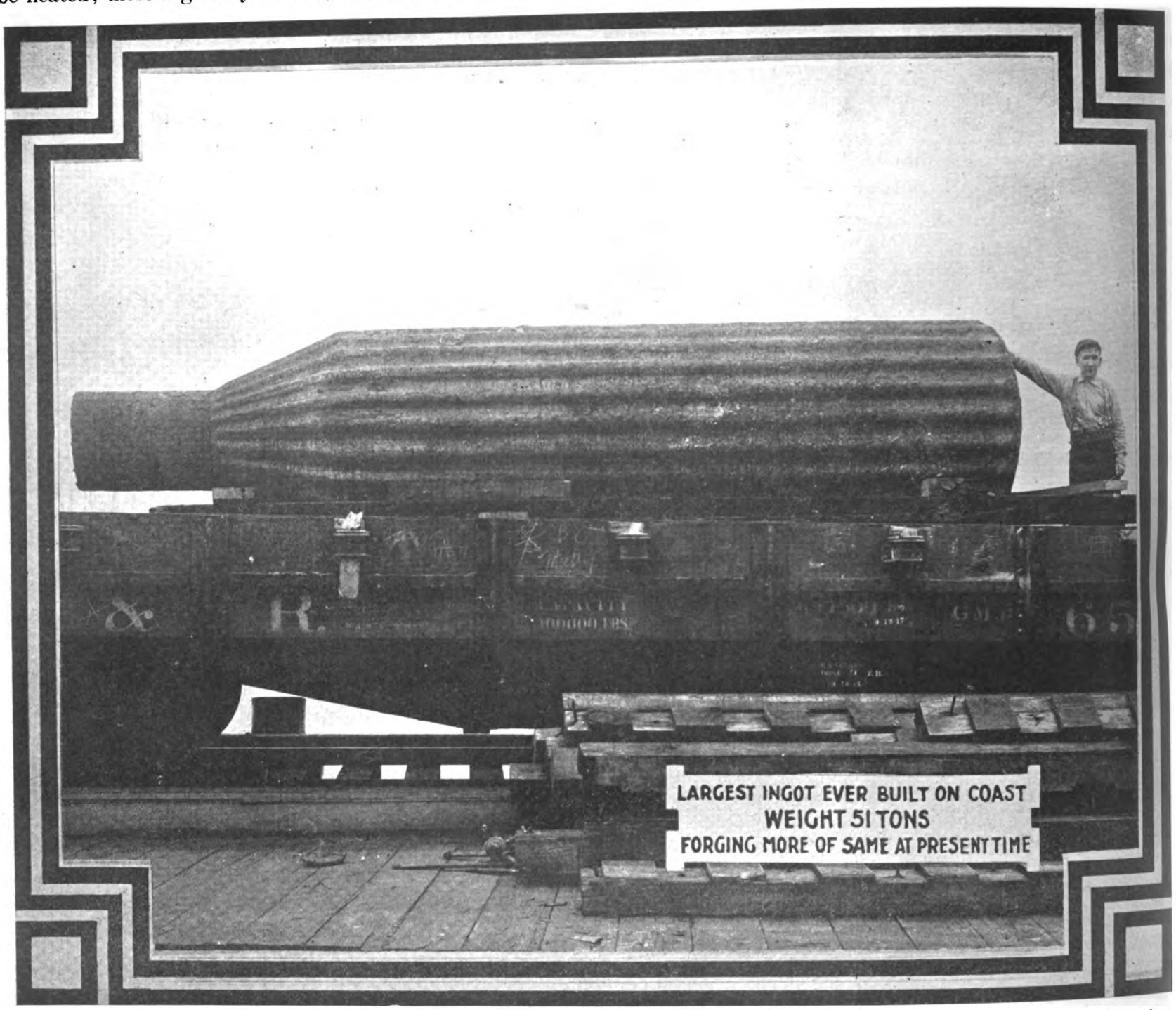
annealing furnace is also heated by means of oil. Steam is supplied to the large presses by means of an oil-fired boiler.

Description of the Process

The steel ingots come into the forging shop at either end by means of a spur track. They are then unloaded and weighed on large Fairbanks Morse platform scales with a capacity of 52 tons. The ingot is then transported by means of the electric cranes to the furnace where it is to be heated; these ingots by the way are approximately 36 inches wide and 15 feet long and weigh in the neighborhood of 51 tons. When they are heated to a working temperature they are taken by the cranes again and placed under the press, where they are worked down to the size for shafting or rudder stock, etc., as required. They are then placed on the floor to cool for a length of time, after which they are placed in the annealing furnace, where they are again subjected to great heat and then taken out to cool the second time. The cranes now take the shafting or whatever kind of forging it may be and place it on the rough turning lathe where it is turned to a sufficient size and then is ready for shipment.

While the ingot is undergoing the forging process there is always left at each end a "test piece" from which test bars are made—two for each forging—one for tensile strength and the other for testing the strength of the metal in bending. These are machined to the proper size and are taken to the testing laboratories, where tests are carried on by the testing engineer of the plant in the presence of the inspector for the prospective owners whoever they may be. They may be the American Bureau of Shipping, British Lloyds or the Bureau Veritas. Should the tests be satisfactory the shaft is accepted provided the surface inspection is also satisfactory.



The steel ingots from which the forgings are made are of the highest quality and are tested for every defect and the workmanship is unexcelled, so that any product turned out by the Pacific Construction and Engineering Company may safely be said to compare favorably with similar products from other plants in every way.

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